AUDIT OF THE OVEC POWER PURCHASE AGREEMENT RIDER OF OHIO POWER COMPANY

PUBLIC VERSION

Prepared for

Public Utilities Commission of Ohio

by

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Audit of the OVEC Power Purchase Agreement Rider of Ohio Power Company: Final report



Prepared for the Public Utilities Commission of Ohio by London Economics International LLC

September 16, 2020

London Economics International LLC ("LEI") was selected by the Public Utilities Commission of Ohio to conduct an independent audit of the Power Purchase Agreement ("PPA") rider of Ohio Power Company ("AEP Ohio") for power provided by Ohio Valley Electric Corporation ("OVEC"). The audit period covers January 1, 2018 through December 31, 2019. The Commission engaged LEI through RFP No. RA20-PPA-1.

LEI's scope of work encompassed the following tasks:

- ***Providing industry context;***
- ***Reconciling OVEC bills and AEP Ohio PPA riders, including assessing accuracy of true up from 2016 to 2019;***
- ***Examining the prudency of OVEC's disposition of energy and capacity;***
- ***Assessing prudency of fuel and variable costs incurred;***
- ***Examining prudency of capital expenses;***
- ***Reviewing environmental compliance activities; and***
- ***Reviewing power plant performance.***

LEI's approach to the audit was to rely on information LEI requested from AEP Ohio, primarily through formal data requests. The financial information used in the audit is therefore from a reliable source. LEI also relied on publicly available data, which is used throughout this report to provide context, comparison, and benchmarks.

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London Economics International LLC ("LEI") shall indemnify, defend, save and hold harmless the Public Utilities Commision of Ohio ("PUCO" or "the Commission"), the State of Ohio, its agents, officers and employees from any and all liabilities, claims, demands or causes of action of whatever kind or nature, including attorneys' fees and court costs arising from the performance of this Contract, to the extent these are caused by LEI's intentionally wrongful, reckless or negligent performance hereunder. If the Commission's tender of defense, based upon this indemnity provision, is rejected by LEI, and LEI is later found by a court of competent jurisdiction to have been required to indemnify the Commission, then in addition to any other remedies the Commission may have, LEI shall pay the Commission's reasonable expenses incurred in proving such indemnification, defending itself or enforcing this provision.

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LEI will only be liable in the case of gross negligence, and under no circumstances shall LEI's liability exceed the total fees actually received by LEI.

1 Executive summary and recommendations

1.1 Objective and purpose

AEP Ohio is an investor-owned electric utility regulated by the Public Utilities Commission of Ohio ("PUCO" or "the Commission"). AEP Ohio is a Sponsoring Company of the Ohio Valley Electric Corporation ("OVEC"), meaning that AEP Ohio, under a contract known as the *Amended and Restated Inter-Company Power Agreement* ("ICPA"), is entitled to a share of OVEC's electricity generation, and must also pay that same share of OVEC's costs.[1] OVEC's generation is provided by two 60-plus year-old coal plants. AEP Ohio's net costs (its share of OVEC's costs less sales of energy and capacity) are passed on to AEP Ohio's ratepayers through the Power Purchase Agreement Rider ("PPA Rider"), established in the Commission's decisions in PUCO Case No. 14-1693-EL-RDR .

The Commission engaged LEI to audit the PPA Rider for the two-year period January 1, 2018 through December 31, 2019. The purpose of the audit is to establish the prudency of all the costs and sales flowing through the PPA Rider, and to investigate whether the AEP Ohio's actions were in the best interest of its retail ratepayers. The costs of the rider are billed by OVEC to AEP Ohio; the sales from the rider are referred to by AEP Ohio as "PJM Liquidation."[2] The OVEC bill and PJM liquidation are discussed in detail in several sections of this report.

1.1.1 LEI general scope of work

LEI's scope of work covers the following items:

1. **Industry context:** A review of the current dynamics of the PJM wholesale markets in which OVEC operates, and the impact that changing market dynamics have on OVEC's operations and practices;
2. **OVEC bill and AEP Ohio rider reconciliation:** Examination of whether charges on the OVEC bill are accurately reflected in AEP Ohio's ledger accounts, and also in the PPA rider;
3. **Accuracy of true up from 2016 to 2019**: an assessment of the accuracy of AEP Ohio's true up from forecasted customer charges to actual customer charges;
4. **Disposition of energy and capacity:** A review of the unit scheduling and offering of energy into PJM administered wholesale markets, offering behavior in PJM administered capacity markets, and offering behavior and/or participation in any other market that may provide revenue above and beyond that which is received in energy and capacity markets;
5. **Fuel and variable costs:** An assessment of OVEC's fuel and variable operations and maintenance-related expenses, including comparison between incurred fuel costs and market prices to evaluate the reasonableness of fuel expenses during the audit period;

[1] LEI-DR-1.6.1 Composite Copy of Inter-Company Power Agreement. Ohio Power Company.

[2] "PJM liquidation" refers to the disposition of AEP Ohio's share of capacity, energy, and ancillary services in the PJM market.

6. **Capital expense:** Examination of the prudency of OVEC's process for allocating and conducting capital projects, and an assessment of whether the fixed costs incurred by OVEC are properly allocated to AEP Ohio, including depreciation, debt service, and plant maintenance expenses;
7. **Environmental compliance:** A review of AEP Ohio's OVEC's environmental compliance activities. This includes, but is not limited to, the impact that compliance activities had on OVEC's fuel procurement strategy, overall emission allowance management strategy, and methods used to analyze compliance options and develop overall mitigation strategies; and
8. **Power plant performance**: A review of significant plant outages or other degradations observed in the operating availability, equivalent availability, or capacity factors of OVEC's generating plants, and an assessment of at least one of OVEC's generating stations based on an on-site investigation.

1.2 LEI's audit approach

LEI's approach to the audit was to rely on information LEI requested from AEP Ohio staff, primarily through formal data requests. LEI also used publicly available data from OVEC annual reports, and other sources of public data.

- LEI issued formal data requests over the time period May 2020 through August 2020, and kept a database and numbering system which logged requests issued and responses received;
- LEI held conference calls and numerous email exchanges;
- Owing to COVID-19 protocols in place at the OVEC plants, which prohibit non-essential personnel from visiting the plants, LEI did not conduct in-person interviews, site visits, or in-camera contract reviews. LEI conducted a single "virtual site visit" to audit the presence and use of environmental control equipment in the plants.

Another key component of LEI's audit was to compare and benchmark the Company's cost and operational results against industry data from publicly available data sources, such as the Energy Information Administration ("EIA"). This public data provided the important context for evaluating OVEC's fuel and power procurement results, as well as results of operations.

This audit report is presented in ten chapters:

Chapter 1: Executive summary and recommendations
Chapter 2: Introduction
Chapter 3: Utility industry context
Chapter 4: OVEC bill and PPA Rider reconciliation
Chapter 5: Disposition of energy and capacity
Chapter 6: Fuel and variable cost expenses
Chapter 7: Capital expenses
Chapter 8: Environmental compliance
Chapter 9: Power plant operations

Chapter 10: Appendix of Acronyms

Chapters 4-9 are organized in the same way, beginning with a statement of the scope of the audit which applies to AEP Ohio's activities, and background information to provide context for these activities; followed by the evaluative criteria used in the audit, LEI's findings, and finally LEI's recommendations.

1.3 LEI's findings and recommendations

Overall, LEI found that the processes, procedures, and oversight were mostly adequate and consistent with good utility practice, given that the ICPA is in place and customers will be charged for the cost of the plants until at least May 2024.

However, LEI's analysis shows at this time that the OVEC plants cost customers more than the cost of energy and capacity that could be bought on the PJM wholesale markets. However, there may be other considerations, such as providing employment at the plants, or the plants' contributions to fuel diversity in the State, that outweigh the impact on ratepayers, which the Ohio legislature takes into consideration.

As detailed in this report, LEI has the following recommendations:

The true up process for the PPA Rider: The true up process between forecasted PPA charges and actual PPA charges involves a 6-month lag. Good accounting practice usually involves timely recording and charging for transactions. LEI recommends the lag be reduced from two billing cycles (six months) to one billing cycle (three months) because actual charges and energy consumption are available within that time frame. However, all true ups were accurate, despite the lag and despite some errors (which impacted forecast costs but not actual costs) in one of the rider statements.

Components of fixed cost: The components of fixed costs were billed properly for the most part, based on reconciliation of the OVEC bill and the PPA Rider, though the reconciliation shows relatively small discrepancies. However, one component of fixed costs, referred to as "Component (D)" in the OVEC bill, is identified by the ICPA as a payment per common share. It is a relatively minor part of the monthly bill to the ICPA participants, though it represents a substantial share of the net profits earned by OVEC. OVEC's capital expenditures are not part of a rate base for which they are allowed a regulated rate of return.

Disposition of energy and capacity: OVEC energy and capacity are sold into the PJM markets; energy is offered as self-scheduled. At a high level, this would be prudent under the ICPA arrangement, as any revenue is helpful to offset costs. However, LEI's analysis showed that some of the time, the PJM energy price did not cover fuel and variable cost, though LEI's analysis did not fully evaluate a re-dispatching of the OVEC units.

Markets can change, so LEI recommends that OVEC re-consider its "must-run" offer strategy (offering energy irrespective of the day ahead market price, discussed in more detail in Section 5) and utilize near-term (one week to one month) demand and price forecasts to formulate offers. During some periods of time, a must-run strategy can be optimal, but at other times it may not.

Fuel and variable cost expenses: Coal inventories were much higher than target levels in 2019. This may indicate a problem with management of contract deliveries versus projected coal burns. However, it was trigged by an event which occurred in one month (April) in 2019 and may be an anomaly, as discussed in Section 6.

Capital expenses: The process of planning and executing individual capital projects appears to be well-managed. However, it appears there is no cap on annual capital expenses. This could lead to over-investment in the plants, as the Commission does not review and/or approve the OVEC capital expenditures as they relate to the AEP Ohio PPA Rider filings (though the Commission does review construction through the power siting process).

Environmental compliance activities: Based on LEI's virtual site visit and follow-up data requests, LEI found that OVEC complied with environmental requirements during the audit period. Management of emissions allowance inventories was reasonable and prudent.

Power plant performance: The plants performed well, with some small exceptions. Plant maintenance costs during outages were budgeted reasonably at Clifty Creek, but the budgeting for Kyger Creek needs to be improved. LEI recommends that OVEC take action to inspect and fix [redacted] to minimize forced outages and the related economic losses.

1.4 Issues and recommendations identified in the previous audit period

LEI also followed up on recommendations from the previous audit, Vantage Energy Consulting LLC. *Independent audit of the Power Purchase Agreement Rider of Ohio Power Company*.[3]

Accounting errors: There had been some errors discovered in the previous audit, some of which were corrected by AEP Ohio for the current audit and others which were not. These errors and the follow-up are discussed in detail in Section 4. The errors did not have a material impact on customers or on AEP Ohio. LEI recommends ongoing monitoring and checking of AEP Ohio's Riders and related data for accuracy, such as were performed during the current audit.

OVEC Operating Committee meetings: The previous auditor noted that OVEC OC meetings should be held more frequently to deal with updates on each plant's operating performance, cost of serve or profit/loss statements for market-based revenues derived from the PJM markets in a more timely manner. AEP Ohio's response for the current audit indicated that they felt the current meeting schedule was adequate and do not plan to make any changes. LEI recommends more frequent meetings to discuss energy offer strategies. This could help prevent plants running when energy prices are too low to cover variable costs.

Study of potential value of offering ancillary services: The previous auditor noted that AEP Ohio should provide PUCO with a study assessing the potential participation in the ancillary services market if the plants are technically able to do so. AEP Ohio indicated that such a study

[3] Public Utilities Commission of Ohio. Docket 18-1003-EL-RDR. Vantage Consulting. *Independent audit of the Power Purchase Agreement Rider of Ohio Power Company*. January 11, 2019; filed August 8, 2019

is under way and will be completed by the end of 2020; the study was not available for review at the time of the audit.

Sliding pressure control: The previous audit recommended that OVEC consider a sliding pressure control strategy to be utilized during low load periods. AEP Ohio agreed to address this with OVEC and the sponsoring parties to evaluate whether this recommendation would be appropriate; it is currently under evaluation.[4]

Performance engineer: The previous audit recommended that OVEC add a Performance Engineer position to the Clifty Creek and Kyger Creek organization. AEP Ohio noted in response to a data request in the current audit that this was implemented through the engineering staff in the Technical department at Kyger Creek, and the Operation department at Clifty Creek, and did not believe that any additional action was necessary.[5]

Jet bubbling reactor ("JBR") scrubber: The previous audit noted that the JBR-46 scrubber was a major availability detractor and recommended that OVEC develop a predictive maintenance program. AEP Ohio noted in response to a data request in the current audit that this was already in place and they believe that no additional action was required.[6]

[4] LEI-DR-13.5.1

[5] LEI-DR-13.5.3

[6] LEI-DR-13.5.2

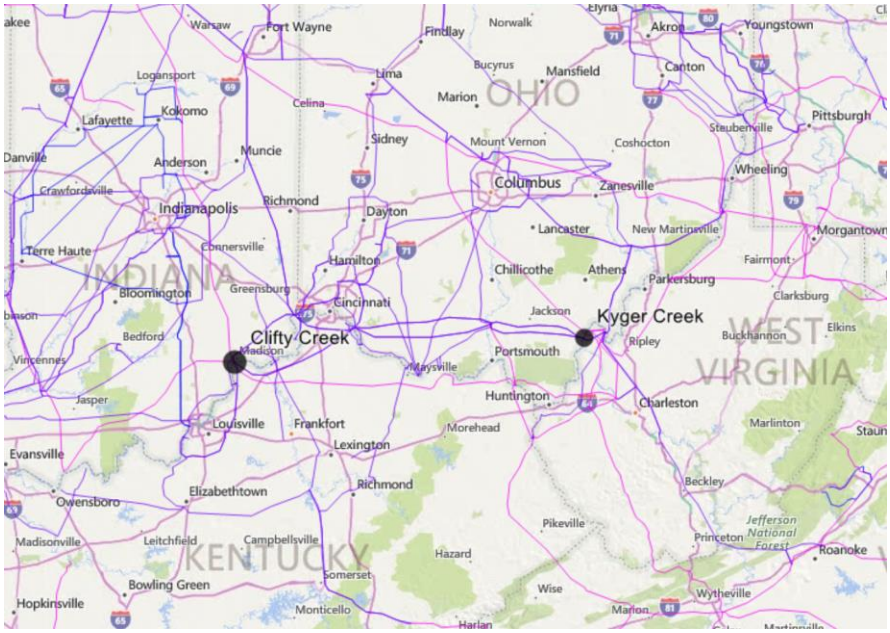
2 Introduction

2.1 Introduction to Ohio Valley Electric Corporation

Ohio Valley Electric Corporation ("OVEC") and its wholly owned subsidiary, Indiana-Kentucky Electric Corporation ("IKEC"), were organized on October 1, 1952. These two companies were formed by investor-owned utilities and their parent companies to serve the large electric power requirements projected for the uranium enrichment facilities under construction by the Atomic Energy Commission ("AEC") near Portsmouth, Ohio.[7] The utilities which own shares of OVEC and are entitled to its output and responsible for its costs are known as the Sponsoring Companies.

The Kyger Creek Power Plant at Cheshire, Ohio, and Clifty Creek Power Plant at Madison, Indiana, are the only power plants owned by OVEC and IKEC. They are both coal plants, with nameplate generating capacities of 1,086 MW (Kyger Creek) and 1,304 MW (Clifty Creek). The two generating stations began operating in 1955/56. They interconnect with the major power transmission network of several of the utilities in the area (see Figure 1).[8]

Figure 1. OVEC generating stations



Source: S&P Global Market Intelligence.

[7] OVEC Annual Report 2018. https://www.ovec.com/FinancialStatements/AnnualReport-2018-Signed.pdf

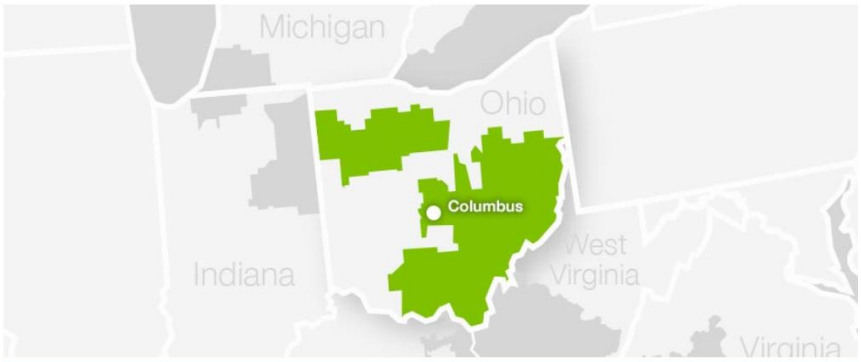
[8] Ibid.

In 2018, the cost of OVEC's power to its owners, the Sponsoring Companies, was $54.29/MWh, and total power costs to the Sponsoring Companies was $644 million.[9] On December 1, 2018, the OVEC-IKEC transmission system integrated into PJM.[10]

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 (see Figure 2). AEP Ohio is a subsidiary of AEP and the largest of AEP's regional utility divisions. AEP Ohio is entitled to 19.93% of OVEC's power, and responsible for the same share of OVEC's costs, though its ownership of two Sponsoring Companies: Columbus Power and the Ohio Power Company. The terms of this entitlement and responsibility for OVEC's costs are set out in the ICPA. The 19.93% share is referred to in the ICPA as the "Power Participation Ratio" ("PPR").

Figure 2. AEP Ohio facts



Customers	1,467,072
Employees	1,415
Transmission Lines	8,195 circuit miles
Distribution Lines	45,718 miles
Assets	$9.8 Billion

Source: AEP Ohio Facts. https://www.aepohio.com/info/facts/Facts.aspx

2.3 Background on the Inter-Company Power Agreement and PPA Rider

In the 1950s, OVEC, the US AEC, and OVEC's owners or their utility company affiliates (the Sponsoring Companies) entered into power agreements to build the two coal plants to serve

[9] OVEC Annual Report 2018. https://www.ovec.com/FinancialStatements/AnnualReport-2018-Signed.pdf

[10] Ibid.

AEC's substantial power requirements. On October 15, 1952, a 25-year agreement was executed by OVEC and AEC, which was later extended to December 31, 2005 under a Department of Energy ("DOE") Power Agreement. As part of this agreement, OVEC and the Sponsoring Companies later (in 1953) signed the ICPA which specified the allocation to each company of power not utilized by the DOE or its predecessors.

On September 29, 2000, the DOE informed OVEC of its cancellation of the DOE Power Agreement. On April 30, 2003, the DOE Power Agreement was terminated.[11] Since time of the DOE Power Agreement termination, OVEC's entire generating capacity has been available to the Sponsoring Companies under the terms of the ICPA. The Sponsoring Companies and OVEC entered into an amended contract, the *Amended and Restated Inter-Company Power Agreement*, effective as of August 11, 2011, which extends to June 30, 2040.[12]

AEP Ohio (the Ohio Power Company plus Columbus Power) is the largest participant in the OVEC power participation benefits and requirements, followed by Buckeye Power Generating, LLC; Appalachian Power Company; and Duke Energy Ohio, Inc. (see Figure 3).[13]

For AEP Ohio, the mechanics of the PPA Rider are as follows: AEP Ohio pays OVEC for its PPR share of the costs associated with the ICPA. AEP Ohio sells its OVEC contractual entitlement (energy, capacity, and non-market-based ancillary services) into the PJM market (referred to by AEP Ohio as "PJM liquidation"). The PJM liquidation proceeds are subtracted from the OVEC contractual costs and the difference is either a credit or a charge to AEP Ohio's customers, and is billed in the PPA Rider.[14] Most of the time the PPA Rider is a charge to customers, not a credit, as demonstrated in Section 4.

[11] OVEC Annual Report 2018. https://www.ovec.com/FinancialStatements/AnnualReport-2018-Signed.pdf

[12] LEI_1.6.1_Attachment _3.

[13] LEI_1.2.21_Confidential Attachment_1

[14] RFP No. RA20-PPA-1

Figure 3. OVEC Sponsoring Company Power Participation Ratios

Sponsoring Company	PPR
Appalachian	15.69
Buckeye	18.00
Cincinnati	9.00
Columbus	4.44
Dayton	4.90
First Energy	4.85
Indiana	7.85
Kentucky	2.50
Louisville	5.63
Monongahela	3.50
Ohio Power	15.49
Peninsula	6.65
So. Indiana	1.50
Total	100.00

Source: LEI 1.2.21 CONFIDENTIAL Attachment 1, p. 134.

The most recent legislation authorizing cost recovery with respect to changes under the ICPA arrangement (House Bill 6, or "HB 6") requires that the cost to residential customers cannot exceed $1.50/month.[15] HB 6 goes on to require that, with respect to OVEC (referred to as "legacy generation resource" in the following quote) *"For all other customer classes, the commission shall establish comparable monthly caps for each class at or below one thousand five hundred dollars per customer. Insofar as the prudently incurred costs related to a legacy generation resource exceed these monthly limits, the electric distribution utility shall defer the remaining prudently incurred costs as a regulatory asset or liability that shall be recovered as determined by the commission subject to the monthly caps set forth in this division."*[16] This means that, though there is a monthly cap on customer charges, there is no cap over time, and any prudently incurred costs greater than the caps can be recovered from customers in the future.

2.4 AEP and OVEC

In addition to AEP Ohio's contract for OVEC generation through the ICPA, AEP as the parent company of AEP Ohio has other points of integration with OVEC. The companies have overlapping management, and OVEC is a customer of American Electric Power Service Corporation ("AEPSC," a subsidiary of AEP).

[15] House Bill 6, effective October 22, 2019. https://www.legislature.ohio.gov/legislation/legislation-summary?id=GA133-HB-6

[16] Ibid.

2.4.1 Overlapping management

AEP and OVEC have overlapping executive management. For example, the Executive Vice-President for Generation of AEP Ohio is also responsible for OVEC/IKEC generating assets, [17] and sits on the Executive Committees of both AEP and OVEC.[18]

2.4.2 Transactions with subsidiaries

AEP and its subsidiary companies owned 43.47% of the common stock of OVEC as of December 31, 2019.[19] In addition, the AEPSC provided about $5 million in services to OVEC in 2018 and 2019.[20] The services included: regular recurring operation and maintenance, and nonrecurring plant construction projects and engineering studies. These costs of these services are incurred by OVEC and paid to AEPSC, and AEP Ohio's PPR share is billed to AEP Ohio customers.

2.5 FirstEnergy Solutions bankruptcy impacted OVEC and AEP Ohio charges

A dispute starting in August 2018 which impacts the cost of the ICPA to AEP Ohio appears to have come to a conclusion. The bankrupt FirstEnergy Solutions ("FES"), now Energy Harbor Corp., initially refused to pay its 4.85% PPR under the ICPA. The dispute involved whether the bankruptcy law was primary (in which case Energy Harbor could abrogate the contract as part of the bankruptcy process) or whether FERC had jurisdiction (in which case the impact on the public interest had to be taken into consideration).[21] FERC argued that "the Bankruptcy Court had to consider the public interest and that the Court could not treat the ICPA contract as just another business contract."[22]

On May 17, 2020, a motion to approve the settlement was filed with the Bankruptcy Court. Energy Harbor agreed to pay OVEC $32.5 million ($10.6 of which was already in escrow) in settlement and dropped its attempt to abrogate the ICPA.[23] The Bankruptcy Court approved the settlement,

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[17] AEP Leadership. https://www.aep.com/about/leadership/chodak and OVEC 2018 annual Report. https://www.ovec.com/FinancialStatements/AnnualReport-2018-Signed.pdf

[18] OVEC Annual Report 2018. https://www.ovec.com/FinancialStatements/AnnualReport-2018-Signed.pdf

[19] OVEC Financial statement 2019. https://www.ovec.com/FinancialStatements/2019-ConsolidatedFinancials.pdf

[20] Ibid.

[21] FirstEnergy Solutions successor faces $500M in damages and a new hearing before FERC. https://www.utilitydive.com/news/firstenergy-solutions-successor-faces-500m-in-damages-and-a-new-hearing-be/575308/

[22] Ibid.

[23] Energy Harbor to Pay OVEC $32.5M in Settlement. https://rtoinsider.com/energy-harbor-ovec-settlement-163883/

and Energy Harbor LLC became a Sponsoring Company of OVEC, taking over FES's 4.85% PPR. This was effective June 1, 2020.[24]

In the meantime, however, as noted by OVEC "Per the ICPA… OVEC made available to all other Sponsoring Companies FES's entitlement to available energy under the ICPA."[25]

[24] Energy Harbor Corp Unaudited Condensed Consolidated Financial Statements for the Quarterly Period Ended: March 31, 2020. https://energyharbor.com/content/dam/akron/investor-relations-pdfs/Energy-Harbor-Quarterly-Results__03.31.2020.pdf

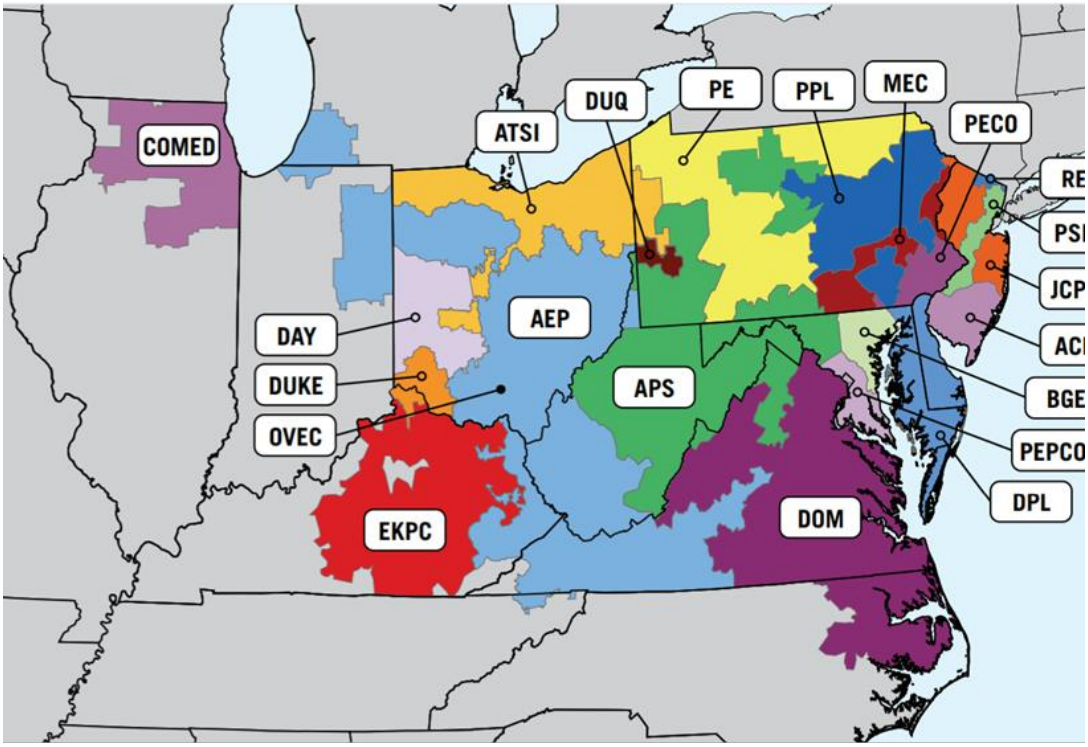
[25] OVEC Annual Report 2018. Pp. 39-40. https://www.ovec.com/FinancialStatements/AnnualReport-2018-Signed.pdf

3 Industry context

To understand LEI's assessment of the prudency of AEP Ohio's PPA arrangement with OVEC, it is important to begin with the context of the electricity industry in PJM.

AEP Ohio and the OVEC plants are located in the PJM Interconnection. PJM is a regional transmission organization ("RTO") that manages grid reliability and wholesale electricity markets for 13 states[26] and the District of Columbia (see Figure 4). AEP is currently one of the five largest owners of installed capacity in PJM.

Figure 4. PJM footprint



Source: Map of PJM territory served. https://www.pjm.com/about-pjm/who-we-are/territory-served.aspx

This chapter discusses the following:

- PJM energy and capacity prices;
- PJM ancillary service markets;
- Self-committing of coal power plants;
- PJM Minimum Offer Price Rule ("MOPR");

[26] All or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

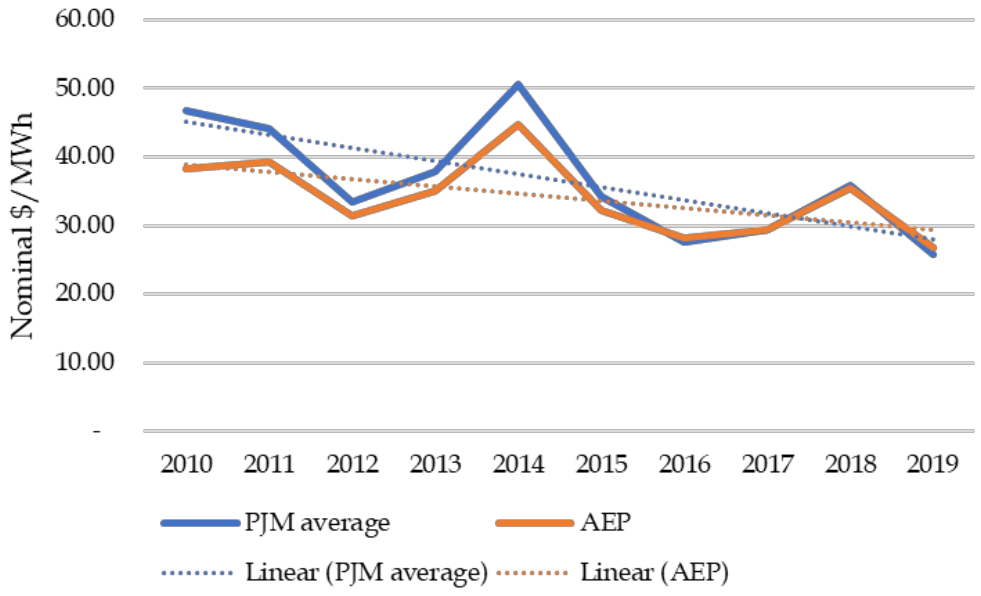
- Levelized cost of new entry in PJM; and
- The ongoing bribery case in Ohio which impacts HB 6.

3.1 PJM energy and capacity markets

3.1.1 PJM energy prices

Wholesale electric energy prices have generally declined since 2010 in the PJM market, except for a spike in 2014 caused by extremely cold weather during the Polar Vortex and a small rise in 2018 as a result of higher natural gas and coal prices, and other drivers. Between 2010 and 2019, day ahead energy prices decreased on average 6.4% per year across the PJM footprint and fell on average 3.9% per year in PJM's AEP Zone (see Figure 5). Day ahead energy prices in PJM AEP zone averaged $35.42/MWh in 2018 and $25.81/MWh in 2019.

Figure 5. Average electric day ahead energy prices (2010-2019)



Source: Third-party data provider.

3.1.2 PJM capacity prices

PJM runs a capacity market to ensure long-term reliability, conducting three-year forward auctions to procure the supply needed to meet predicted demand. It is referred to as the Reliability Pricing Model ("RPM"). The RPM is a series of auctions for delivery in the future. The majority of capacity is procured in the first auction for a particular delivery year, which is known

as the Base Residual Auction ("BRA"), conducted three years in advance of a given delivery year.[27]

Capacity clearing prices in the BRA have fluctuated in recent years (see Figure 6). PJM transitioned to procuring only capacity performance ("CP") products starting in the 2020/2021 delivery year. New entry, retirements, and changes in parameters affecting the demand curve impact capacity prices.

Figure 6. PJM RTO base residual 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

Note: AEP Ohio zone is included in PJM RTO capacity zone.
Source: PJM

In the PJM auction held in May 2018 for the 2021/22 delivery year, the RTO zone cleared at $140.00/MW-day. The auction for 2022/23 was delayed, and therefore no clearing prices are available.

The sum of average day ahead energy price in 2018 ($35.42/MWh, noted previously) and capacity clearing price earned in 2018 add up to $41.25/MWh. This is lower than $54/MWh, the total cost of power from the OVEC power plants in 2018, as reported by OVEC.[28] On average, then, in 2018 OVEC power cost customers about $13/MWh more than energy and capacity purchased in the PJM market.

3.2 PJM ancillary service markets

Ancillary services help to balance the transmission system as it moves electricity from generating sources to ultimate consumers.

Regulation and reserves are two categories of ancillary services. PJM operates a market for regulation services (the Regulation Market). It also operates markets for reserves (the Synchronized Reserve Market, the Non-Synchronized Reserve Market, and the Day-Ahead Scheduling Reserve Market).[29]

- **Regulation** helps to control small mismatches between load and generation. Currently, steam (coal and natural gas), combustion turbines (natural gas, oil, methane, and biomass), hydro, storage (batteries, flywheels, and hot water heaters), and demand response participate in the PJM Regulation Market, which provides market-based

[27] Capacity Market/RPM FAQs. https://learn.pjm.com/three-priorities/buying-and-selling-energy/capacity-markets/capacity-markets-faqs.aspx

[28] OVEC 2018 annual report. https://www.ovec.com/FinancialStatements/AnnualReport-2018-Signed.pdf

[29] PJM Ancillary Service https://www.pjm.com/markets-and-operations/ancillary-services.aspx

compensation to those resources that can adjust output or consumption in response to an automated signal.[30]

- **Reserves** are used to recover system balance by making up for generation deficiencies if there is loss of a large generator. There are three major categories of reserves: operating reserves, which must be available within 30 minutes; primary reserves, which must be available within 10 minutes; and synchronized reserves, grid-connected power that must be available within 10 minutes. All three reserves can be supplied by generators that are connected to the electric grid, and/or by demand side response. Operating reserves and primary reserves can also be supplied by offline generators.

The other ancillary service products are not purchased or sold through a market-based system. For instance, generators need to provide Day-Ahead Scheduling Reserve and Balancing Operating Reserve as a virtue of being online or being integrated into the PJM system.[31]

In PJM's most recent Quarterly State of the Market Report posted on August 13, 2020, the independent market monitor evaluated the synchronized reserve market, the day-ahead scheduling reserve market and the regulation market and found that they were not competitive in their market structure because of high levels of supplier concentration and failures of pivotal supplier test. The independent market monitor recommended that PJM should increase the competitiveness of the market structure and make the ancillary service market more efficient.[32]

3.3 Coal self-commitment in RTOs

As discussed in more detail in Section 5, the OVEC coal units (except for Clifty Creek Unit 6) are self-scheduled, and therefore operate as baseload capacity in the PJM market. Self-scheduling means that the market participant schedules the unit to run regardless of energy prices. To be clear, the OVEC units are not offered as "reliability must-run" units; simply as must-run units.

Recently, the practice of self-committing coal plants has been under discussion among stakeholders in the United States. The Union of Concerned Scientists ("UCS"), Sierra Club, and others recently published reports that find self-commitment of coal-fired power plants is costing consumers millions of dollars annually across wholesale power markets.[33] Some utilities in the Midcontinent Independent System Operator ("MISO") area argue "self-commitment is an important and necessary mechanism to avoid high startup and shutdown costs,"[34] but others have begun shifting away from self-committing and towards economic dispatch and seasonal

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[30] PJM Ancillary Service https://www.pjm.com/markets-and-operations/ancillary-services.aspx

[31] LEI-DR-5.1.4

[32] PJM 2020 Q2 Quarterly State of the Market Report. https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2020/2020q2-som-pjm.pdf

[33] UCS Analysis Knocks Coal Self-commitments. https://rtoinsider.com/ucs-analysis-knocks-coal-self-commitments-164527/

[34] Ibid.

commitments in response to increased regulatory scrutiny. Former FERC Commissioners noted "state regulators have a vital role to play in determining whether such practices should fundamentally change a state's regulatory policy."[35]

3.4 PJM Minimum Offer Price Rule ("MOPR")

The PJM MOPR is intended to prevent the exercise of buyer-side market power. It is intended to ensure that certain new resources and uprates are not offered into the RPM capacity auctions at artificially low prices. The MOPR "imposes a minimum offer screening process to determine whether an offer from a new resource is competitive and prevents market participants from submitting uncompetitive, low new entry offers in RPM auctions."[36] The concern is that resources which might have out-of-market compensation or a subsidy could artificially depress auction clearing prices.[37]

Under PJM's original order, the MOPR was largely aimed at new natural gas resources. But FERC proposed to administratively raise the bids of any new resource in the market that receives a state subsidy.[38]

The MOPR is being intensely debated. Rehearing requests filed with FERC in January 2020 seek clarification on the many uncertainties in the order, including the definition of a state subsidy and the scope of the exemptions for existing renewable resources. Concerns include:

1) discrimination between new and existing resources in the capacity market;
2) encroaching on the states' jurisdiction over their own generation mix; and
3) making the capacity market less efficient.

If the MOPR stands, state-subsidized resources are less likely to clear the capacity market because they will have to offer higher prices. The higher capacity prices could benefit fossil fuel generators, such as OVEC.

But this assumes that all the PJM states will stay in the capacity market. They may choose not to, because states pursuing clean energy resources will effectively have to pay twice for capacity — once for the capacity from the clean energy resources sponsored by the state (that cannot clear the capacity market) and again for additional capacity from the PJM capacity market. This may

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[35] Ex-FERC commissioners debate solutions to coal self-commitments said to cost millions. Utility Dive https://www.utilitydive.com/news/ex-ferc-commissioners-debate-solutions-to-coal-self-committment-said-to-cos/578935/

[36] Minimum Offer Price Rule ("MOPR") Overview and Exemption Process. https://www.pjm.com/-/media/committees-groups/task-forces/ccppstf/20170912/20170912-mopr-education.ashx

[37] Ibid.

[38] FERC MOPR order may have 'paradoxically unintended consequences': PJM. https://www.utilitydive.com/news/ferc-mopr-order-may-have-paradoxically-unintended-consequences-pjm/570880/

prompt states and utilities to withdraw from PJM's capacity market altogether, under the Fixed Resource Requirement ("FRR") alternative. Under FRR, utilities procure capacity themselves through bilateral contracts, rather than in the capacity market. States with significant renewable energy mandates or subsidized nuclear programs include Maryland, New Jersey, Illinois, Ohio, and Virginia, which together account for over half of PJM's load. PJM's capacity market could clear at lower prices if many states adopt the FRR, because their demand for capacity would be withdrawn from the market.

On March 18, 2020, PJM submitted their compliance filing to FERC. In this filing they proposed a tight timeline for the next three capacity auctions, a timeline which depends on the date that FERC approves the filing. Provided FERC approves the filing by September 2020, the latest date by which PJM would complete the BRA for 2022/23 would be March 31,2021. If approval comes later, PJM's schedule would revert to holding the auction six months after FERC approval. The filing also confirmed the price floors for various resources and clarified exceptions to the MOPR. Notable exceptions to the rule included renewables in state Renewable Portfolio Standard ("RPS") programs, demand response and energy efficiency, storage, self-supply, federal subsidies such as the Regional Greenhouse Gas Initiative ("RGGI") as well as any resource that can demonstrate actual costs are less than the MOPR floor price.[39]

On June 1, PJM submitted a second compliance filing to FERC, with details on how the auction would be competitive and resource neutral. The proposed timelines for BRA auctions were not changed.[40] As of August 31, 2020, FERC has not yet approved the compliance filing.

3.5 Levelized cost of new entry in PJM

The price of energy and capacity price in PJM totaled $41.25/MWh in 2018 as noted previously. This is slightly too low to support investment in a new (generic) combined cycle gas turbine ("CCGT"): LEI's analysis indicates that a new CCGT has a levelized cost of energy ("LCOE") of $42.40/MWh for PJM West and $47.50/MWh for PJM East (see Figure 7). LCOE is an analytical tool that measures lifetime costs of a power plant divided by its lifetime energy production. It calculates the present value of the total cost of building an operating a new plant and spreads this cost over all the MWhs the plant is assumed to produce in its lifetime. Thus, LCOE is a $-MWh measure that can be compared to market prices. If expected market prices are higher than the LCOE of a plant, it is s signal that an investor could earn an attractive return—it is a signal to build a plant. If expected market prices are lower than the LCOE, it is a signal not to build a plant.

[39] Hale, Z (2020). PJM responds to FERC-ordered capacity market overhaul with tight timelines. S&P Global. Retrieved from https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/pjm-responds-to-ferc-ordered-capacity-market-overhaul-with-tight-timelines-57652646

[40] PJM June 1 Compliance filing. https://pjm.com/directory/etariff/FercDockets/4571/20200601-er18-1314-006.pdf

Figure 7. Cost of generic new entry for PJM, 2021

2021	CCGT (PJM West)	CCGT (PJM East)
Capital cost [$/kW]	$ 1,339	$ 1,443
Leverage [%]	60%	60%
tax rate [%]	45%	44%
Debt interest rate [%]	6%	6%
Cost of debt (post-tax) [%]	3%	3%
Post-tax required equity return [%]	9%	8%
pre-tax equity return [%]	16%	15%
WACC [%]	8%	8%
Project life [year]	15	15
Construction time [month]	24	24
Heat rate [Btu/kWh]	6,431	6,431
Nominal variable O&M [$/MWh]	$ 2.6	$ 2.6
Nominal fixed O&M [$/kW/year]	$ 20.6	$ 18.2
Capacity factor [%]	83%	78%
Fuel price [$/MMBtu]	$ 2.3	$ 2.7
All-in fixed cost [$/kW/year]	$ 179.8	$ 187.3
Levelized non-fuel cost of new entry [$/MWh]	$ 27.3	$ 30.0
Levelized cost of new entry [$/MWh]	$ 42.4	$ 47.5

Notes:
1. Capital cost of CCGT includes carrying charges over the construction period.
2. All-in fixed cost includes interest and principal debt payments and fixed O&M.
3. Gas price for PJM West is based on Dominion South; gas price for PJM East is based on Transco-Z5.
Sources: PJM MOPR Price Calculations, EIA AEO 2020, LEI

At $42.40/MWh to $47.50/MWh a new CCGT would not be expected to able to earn a commercially reasonable return in PJM, if energy and prices were expected to remain at recent low levels. Therefore, such an investment would not be pursued. Since the cost of the OVEC plants, at over $50/MWh is even higher than the levelized cost of building a new CCGT, it also implies that in a competitive context, the OVEC plants would not be viable on a going-forward basis.

LEI's LCOE analysis in Figure 7 above contrasts with the analysis provided by AEP Ohio in Summary of Benchmark Study (beginning on page 28 of the *Amended and Restated ICPA)*.[41] The Benchmark Study results are based on Energy Information Administration data from 2010, which puts the levelized cost of energy from a CCGT at $96.53/MWh. This cost is much higher than LEI's LCOE partly as the result of the assumed prices for natural gas used in the analysis. In the time since 2010, natural gas prices have declined, reducing the LCOE for new CCGTs.

3.6 Federal bribery charges relate to House Bill 6 ("HB 6")

The Ohio legislation known as HB 6, signed into law in 2019, modified existing recovery to be statewide (i.e., collected from non-OVEC electric distribution utility customers) and imposed rate caps related to recovery of costs under the ICPA. HB 6 refers to "legacy generation resources,"

[41] LEI_1.6.1_Attachment 3.

which include "*all generating facilities owned directly or indirectly by a corporation that was formed prior to 1960 by investor-owned utilities for the original purpose of providing power to the federal government for use in the nation's defense or in furtherance of national interest, including the Ohio Valley Electric Corporation.*"[42] HB 6 provides that "*The commission shall determine the proper rate design for recovering or remitting the prudently incurred costs related to a legacy generation resource….*"[43] In other words, the ICPA is enabled by HB 6.

HB 6 also provides subsidies for two large nuclear power plants in Ohio, and for that reason is the center of a federal bribery investigation.

[42] House Bill 6, effective October 22, 2019. https://www.legislature.ohio.gov/legislation/legislation-summary?id=GA133-HB-6

[43] Ibid.

4 OVEC bill and PPA Rider reconciliation

4.1 Scope and background

4.1.1 Scope

As noted above, as a Sponsoring Company, AEP Ohio is responsible for a 19.93% PPR share of the costs and revenues of the two OVEC plants, as AEP Ohio is the parent company of Ohio Power (with a 15.49% share) and Columbus power (with a 4.44% share). The PPR share is billed to AEP Ohio customers in the PPA Rider of Ohio Power Company and is therefore within the scope of this audit.

This chapter addresses the following topics:

- The details of the monthly OVEC bills from January 2018 to December 2019in which all the charges and credits to AEP Ohio and the other members of the ICPA are detailed. [44]
- The quarterly PPA Rider, which details the forecasted monthly PPA charges to AEP Ohio's customers, the actual monthly PPA charges, and the true up process for reconciling forecast to actual charges.

In coming to LEI's conclusions, LEI issued formal data requests, corresponded by email, and held conference calls with Company personnel.

4.1.2 Background of PPA Rider

In February 2015, the Commission approved AEP Ohio's electric security plan ("ESP") for June 1, 2015 through May 31, 2018 (Case No. 13-2385-EL-SSO, et al), approving the establishment of a PPA Rider. This was subsequently modified in re-hearings, but the terms related to OVEC remained intact.

On November 23, 2016, AEP Ohio filed an amended application with the Commission requesting that its ESP be extended through May 31, 2024 (Case No. 16-1852-EL-SSO, et al). The Commission issued its Opinion and Order on April 25, 2018, which generally authorized AEP Ohio to continue to include the OVEC entitlement in the PPA Rider through May 31, 2024.

4.2 Evaluative criteria

LEI focused its audit of the OVEC bill and PPA Rider on answering the following questions:

- Are AEP Ohio's Journal 2061 entries consistent with monthly bills provided by OVEC?
- Are the actual monthly PPA charges which appear in the quarterly PPA Rider statements consistent with the monthly bills provided by OVEC, which AEP Ohio pays?

[44] LEI_1.2.21_CONFIDENTIAL_Attachment_1.

- What is the cost of the ICPA on a per MWh basis?
- Did AEP Ohio perform the PPA Rider 2016 true ups correctly?
- Did AEP Ohio perform the PPA Rider 2018 and 2019 true ups correctly?
- Is AEP Ohio's PPA Rider true up process in the best interest of ratepayers?

4.3 Findings and conclusions

4.3.1 OVEC bill, journal entries, and rider charges are consistent

AEP Ohio provided its complete monthly bills from OVEC for January 2017 through December 2019, in LEI_1.2.21_CONFIDENTIAL_Attachment_1. LEI selected 6 months for a detailed examination: January 2018, February 2018, July 2018, October 2018, April 2019, and August 2019.

4.3.1.1 Analysis

LEI examined AEP Ohio's journal entries for "Accounts Included in OVEC PPA Rider" (Journal 2061) provided by AEP Ohio in LEI_1.6.4 Attachment 1. The actual demand changes are contained in account number 5550095, and the actual energy charges are in account 5550114 (see column A and column B of Figure 8). The total of energy plus demand charges is shown in column C of Figure 8.

The OVEC bills, which detail the Total Monthly Charge to Ohio Power and Columbus Power were provided by AEP Ohio in the "Summary" pages of LEI_1.2.21_CONFIDENTIAL_Attachment_1 (see column "D" in Figure 8).[45] For January 2018, February 2018, July 2018, October 2018, April 2019, and August 2019, LEI confirmed that the OVEC bill totals and the energy plus demand charges in Journal 2061 were the same (see column E in Figure 8). This means Journal 2061 entries are consistent with the OVEC bill, as they should be.

[45] LEI_1.2.21_CONFIDENTIAL_Attachment_1.

Figure 8. Reconciliation of OVEC bill and detailed monthly journal entries



Source: LEI_1.6.4 Attachment 1 (Journal 2061) "Data" Tab, and LEI_1.2.21_CONFIDENTIAL_Attachment_1.

LEI next reconciled Journal 2061 entries with the actual rider charges. Journal 2061 entries specify a credit for PJM liquidation—this is what the OVEC plants earned in the PJM market (see column 1 of Figure 9 below). The total energy charges appear in column B of Figure 9; note that these match column C and D of Figure 8 shown previously, as they should. Summing the liquidation credits and the energy and demand charges results in the net credit or charge which should appear on the PPA Rider (column C of Figure 9). LEI then compared this sum to the actual PPA Rider charge, shown in column D of Figure 9. The reconciliation (column E) shows that these two totals are either identical, or within a few cents or dollars of one another. LEI is satisfied that the totals are close enough to conclude that the PPA Rider is an accurate reflection of the net cost of the rider to AEP Ohio.

Figure 9. Reconciliation of journal entries and rider charge



Source: LEI_1.6.4 Attachment 1 (Journal 2061) "Data" Tab, LEI_1.6.2_Attachment_3, LEI_1.6.2_Attachment_5, 1.6.2_Attachment_6, 1.6.2_Attachment_9, and LEI_1.6.2_Supplemental_Attachment_10.

4.3.1.2 Recommendations

In summary, LEI concludes that the OVEC bills, Journal 2061 entries, and the actual charges on the PPA Rider bills are consistent with one another. LEI has no recommendations on this topic. However, LEI notes that, except for January 2018, the earnings from PJM liquidation in the sample months did not cover the OVEC charges, and the net to AEP Ohio's customers was a charge, not a credit.

4.3.2 Were components of fixed costs (capital costs) billed properly?

The RFP requires the auditor to ensure that any fixed costs incurred by OVEC are properly allocated to AEP Ohio, including depreciation, debt service, and plant maintenance expense.[46] These fixed costs comprise the demand charges in the OVEC bill. LEI examined six months of OVEC bills, as described below, to determine if these were billed correctly to AEP Ohio.

4.3.2.1 Analysis of billing of fixed costs

First, LEI examined OVEC bills to determine the overall components of fixed costs. These components included Components A-F as found in the OVEC bill on, for example, page 137 (for January 2018). The total demand charge for January 2018 was [redacted] (see Figure 10). The OVEC bill includes PJM fees and PJM charges or credits in the demand portion of the bill. These are shown in the last column of Figure 10.

Figure 10. Total demand charges payable to OVEC from all participants

[redacted]

Source: LEI 1.2.21 CONFIDENTIAL Attachment 1 ("OVEC bill")

Next, LEI calculated AEP Ohio's share of these charges in the following manner: AEP Ohio's share of the demand charges is assumed to be its PPR of 19.93%. Its share of the PJM charges is 21.63% (for example, see page 143 of 421 of LEI 1.2.21 CONFIDENTIAL Attachment 1). Multiplying the PPR share by the total demand charges and the PPR PJM share by the PJM expenses in Figure 10 gives the charges that should be billed to AEP Ohio (see Figure 11). For example, for January 2018, the total demand charge plus PJM costs amounted to $[redacted] (see Figure 11, fourth column).

[46] Request for Proposal No. RA20-PPA-1, P. 6.

Figure 11. Total demand charges payable to OVEC from AEP Ohio, reconciled with Journal 2061



Source: LEI 1.2.21 CONFIDENTIAL Attachment 1 and LEI 1.6.2 Attachments, Schedule 3 (various)

Finally, LEI compared the actual demand charge from Journal 2061, account number 5550095 with the fourth column in Figure 11. The results were close, as seen in the fifth column in Figure 11, but did not match exactly. The differences could be owing to rounding error in the OVEC bill versus the journal accounts, except for April 2019 and August 2019, where the differences were greater than +/- $200. During those two months, there were PJM charges and credits related to PJM External accounts; it is possible the discrepancy results from the PJM charges.

4.3.2.2 Recommendations

It appears that the components of fixed costs were billed properly, though the reconciliation shows relatively small discrepancies. LEI has no recommendations related to the reconciliation.

However, LEI notes that Component (D) of the demand charge "is an amount equal to the product of $ multiplied by the total number of shares of capital stock of the par value of $100 per share."[47] At per month, this amounts to $ million per year which is ultimately paid by ratepayers including AEP Ohio's customers. This $ million per year amounts to a very large share of OVEC's net income of million in 2018 and million in 2019, though it is not a large share of the overall OVEC bill to ratepayers.[48]

[47] See, for example, LEI-DR-1.2.21 CONFIDENTIAL Attachment 1, p 137 of 421.

[48] OVEC Annual Report 2019.

4.3.3 The OVEC plants cost more than they earn

Although it is obvious from the fact that the PPA Rider is usually a charge to AEP Ohio customers and not a credit, it is helpful to see the costs of the OVEC plants in the context of the PJM energy and capacity markets.

4.3.3.1 Analysis

For six sample months during the audit period, LEI calculated that the cost of OVEC demand charges was a weighted average of [redacted]/MWh; and energy charges were [redacted]/MWh (see Figure 12). LEI computed this by adding the total OVEC demand and energy charges and dividing by the total available energy used to bill the Sponsoring Companies. Costs per MWh were particularly high in April 2019, because the plants operated at a low capacity factor, providing only [redacted]. In April 2019 there were a large number of forced outage hours, discussed in more detail in Section 9, which could account for the low level of generation.

Figure 12. OVEC cost of power (demand and energy charges) for sample months during audit

[redacted]

Source: LEI 1.2.21 CONFIDENTIAL Attachment 1

This analysis confirms that the ICPA costs AEP Ohio more than the value of the OVEC plants' energy and capacity in the PJM market.

This conclusion is consistent with the net impact on AEP Ohio's PPA Rider. OVEC bills AEP Ohio for its entitlement to the output of the plants. AEP Ohio sells this entitlement into PJM, for a net deficit. The difference is billed to AEP Ohio's customers, in the PPA Rider.

4.3.3.2 Recommendations

The current ICPA does not expire until June 30, 2040. AEP Ohio customers could be locked into paying a premium for energy and capacity from the OVEC plants for up to another 20 years, though market prices could change in the future, and the premium could become a discount. The

expiry of the ESP in May 2024 could provide an opportunity for regulators to re-examine the ongoing approval of the PPA Rider retail cost recovery mechanism.

4.3.4 2016 true ups were correctly reflected in the monthly PPA Rider charges

Staff asked LEI to perform an analysis of AEP Ohio's charges and true up of 2016 PPA Rider costs. The 2016 actual charges were not charged to customers in 2016, but were charged in 2017, with a portion of the true up for these appearing in 2018 PPA Riders.

The PPA charges for 2016 amounted to $21,763,057.00 (see Figure 13).

Figure 13. Actual PPA charges for 2016

Jun	$ 2,700,465.00
Jul	$ 1,893,857.00
Aug	$ 2,294,807.00
Sept	$ 2,403,712.00
Oct	$ 4,120,794.00
Nov	$ 4,524,796.00
Dec	$ 3,824,626.00
Total	**$ 21,763,057.00**

Source: Vantage Energy Consulting LLC. *Independent audit of the Power Purchase Agreement Rider of Ohio Power Company*. January 11, 2019. P. 32.

The 2016 charges began to be recovered in 2017, based on forecasts. One-quarter of the total 2016 charge of $21,763,057 (i.e., $5,440,764) was distributed across the forecast of energy sales each quarter, to arrive at a $/kWh charge for each quarter. Therefore, in a quarter in which energy sales were ultimately higher than forecasted, more than $5,440,764 would be recovered. Similarly, in a quarter in which sales were ultimately lower than forecasted, less than $5,440,764 would be recovered. These over-recoveries and under-recoveries had to be trued up in following quarters.

As described below, LEI examined AEP Ohio's process to determine whether the true ups were accurate.

4.3.4.1 Analysis of 2016 charges

LEI examined the actual 2016 costs which were recovered in 2018. By Q1 2018, $18,461,244 of the $21,763,057 had already been collected from customers. The remainder, $3,301,812 was charged to customers (see Figure 14). This resulted in over-collection of the 2016 PPA charge by $1,805,359. This amount, or rather, $1,805,357 (difference owing to rounding error) was returned to customers in the Q2 2018 Rider (see Figure 15).

Figure 14. AEP Ohio's true ups of 2016 actual costs

		PPA cost used for forecast			
Q1 2017	$	5,440,764			
Q2 2017	$	5,440,764			
Q3 2017	$	5,440,764			
Q4 2017	$	5,440,764			
Total	**$**	**21,763,056**			
		Q1 2018 Rider: Cumulative 2016 PPA revenues received from customers			
Q1 2017	$	6,259,371	Actual		
Q2 2017	$	5,043,635	Actual		
Q3 2017	$	3,579,119	Actual		
Q4 2017	$	3,579,119	Estimated		
Total	**$**	**18,461,244**			
				Remainder, collected on Q3 2018 Rider:	**$ 3,301,812**
		Q2 2018 Rider: Cumulative 2016 PPA revenues received from customers			
Q1 2017	$	6,259,371	Actual		
Q2 2017	$	5,043,635	Actual		
Q3 2017	$	3,579,119	Actual		
Q4 2017	$	5,384,476	Actual		
Q1 2018	$	3,301,814	Estimated		
Total	**$**	**23,568,415**		Over-recovery, returned to customers on Q2 2018 Rider:	**$ (1,805,359)**
		Q3 2018 Rider: Cumulative 2016 PPA revenues received from customers			
Q1 2017	$	6,259,371	Actual		
Q2 2017	$	5,043,635	Actual		
Q3 2017	$	3,579,119	Actual		
Q4 2017	$	5,384,476	Actual		
Q1 2018	$	1,496,457	Actual		
Total	**$**	**21,763,059**			**$ (2.62)**

Source: LEI_1.6.4_Attachment _1, LEI_1.6.4_Attachment _2, LEI_1.6.2_Attachment_3, LEI_1.6.2_Attachment_4, LEI_1.6.2_Attachment_5, LEI_1.6.2_Attachment_6, LEI_1.6.2_Attachment_7, LEI_1.6.2_Attachment_8, LEI 1.6.2_Attachment_9, and LEI_1.6.2_Supplemental_Attachment_10.

Figure 15. AEP Ohio final reconciliation of 2016 PPA charges

Schedule 3

OHIO POWER COMPANY
Calculation of Quarterly PPA For Billing During
April through June 2018
Reconciliation Component (Actuals)

Line	Month	PPA Revenue	PPA Cost	PPA (Over)/Under Recovery
1	**Beginning Balance**		**$ 21,763,059**	$ -
2	Jan-Mar 2017	$ 6,259,371		$ 15,503,688
3	Apr-Jun 2017	$ 5,043,635		$ 10,460,052
4	Jul-Sep 2017	$ 3,579,119		$ 6,880,933
5	Oct-Dec 2017	$ 5,384,476		$ 1,496,457
6	Forecast Jan-Mar 2017	$ 3,301,814		$ (1,805,357)
7	**Ending Balance**	$ 23,568,415	$ 21,763,059	$ (1,805,357)

Source: LEI_1.6.4_Attachment 2, "Schedule 3" tab. Note that "Forecast Jan-Mar 2017" is an incorrect label. It should have read "Forecast Jan-Mar 2018."

4.3.4.2 Recommendations

LEI found the true up of 2016 charges were consistent with the quarterly PPA Riders and has no recommendations. AEP Ohio's true up is accurate.

4.3.5 The billing process involves an unnecessarily long lag before true up

As noted above, AEP Ohio uses a six-month lag between estimated PPA Rider charges and actuals. LEI examined forecasted and actual PPA charges for 2018 and 2019 to determine whether the true up process was accurate, and to examine the impact on customers and AEP Ohio of the six-month lag in the AEP Ohio's true up process.

4.3.5.1 Analysis

LEI compared the monthly actual PPA charges to customers in the PPA Rider (column A in Figure 16) with actual revenues received from customers (column B in Figure 16). The amount of monthly over recovery or under recovery is shown column C. The cumulative balance (column D) shows that AEP ran an over-recovery balance thru 3Q 2018 (entries are negative), but since then has under-recovered (entries are positive). The cumulative balance begins in June 2017 at ($1,910,626).[49] This negative number indicates that AEP Ohio had over-recovered the PPA charges up to that date. Then, in column D LEI tracks the impact of over or under recovery (column C) on the cumulative balance (column D).

[49] LEI_1.6.2_Attachment_1, "Schedule 3" tab.

Figure 16. AEP Ohio 2017-2019 true up process summary

Month in which actual costs were incurred and actual revenues earned	A: Actual PPA charge (from Schedule 3, with a 6-month lag)	B: PPA revenue recovered from customers (from Schedule 3, with a 6-month lag)	C = A -B: (Over) or under recovery	D: Cumulative balance (LEI calculation)	E: Schedule 3 Beginning Balance	F = D -E	Forecast PPA changes reflected in rates	(Over)/under-recovery reflected in rates
				$ (1,910,626)				
Jul-17	$ 2,190,990	$ 2,891,400	$ (700,410)	$ (2,611,036)				
Aug-17	$ 2,750,696	$ 3,184,972	$ (434,277)	$ (3,045,312)				
Sep-17	$ 4,218,121	$ 2,811,875	$ 1,406,246	$ (1,639,066)	(1,638,974)	(92)	Jul-17	Jan-18
Total	**$ 9,159,807**	**$ 8,888,247**	**$ 271,560**					
Oct-17	$ 4,257,282	$ 3,379,342	$ 877,941	$ (761,125)				
Nov-17	$ 3,312,048	$ 3,166,782	$ 145,265	$ (615,860)				
Dec-17	$ 1,806,719	$ 3,694,242	$ (1,887,524)	$ (2,503,384)	(2,503,292)	(92)	Oct-17	Apr-18
Total	**$ 9,376,049**	**$ 10,240,367**	**$ (864,318)**					
Jan-18	$ (2,987,648)	$ 1,331,265	$ (4,318,913)	$ (6,822,297)				
Feb-18	$ 3,380,238	$ 2,928,509	$ 451,729	$ (6,370,568)				
Mar-18	$ 1,683,784	$ 3,374,737	$ (1,690,952)	$ (8,061,520)	(8,061,428)	(92)	Jan-18	Jul-18
Total	**$ 2,076,374**	**$ 7,634,511**	**$ (5,558,136)**					
Apr-18	$ 3,595,083	$ 1,854,426	$ 1,740,657	$ (6,320,863)				
May-18	$ 4,077,787	$ 2,239,701	$ 1,838,086	$ (4,482,777)				
Jun-18	$ 2,084,600	$ 2,427,991	$ (343,391)	$ (4,826,168)	(4,826,076)	(92)	Apr-18	Oct-18
Total	**$ 9,757,470**	**$ 6,522,118**	**$ 3,235,352**					
Jul-18	$ 1,925,443	$ (669,833)	$ 2,595,276	$ (2,230,892)				
Aug-18	$ 2,219,307	$ 209,816	$ 2,009,491	$ (221,402)				
Sep-18	$ 2,228,975	$ 228,882	$ 2,000,093	$ 1,778,691	1,778,783	(92)	Jul-18	Jan-19
Total	**$ 6,373,725**	**$ (231,135)**	**$ 6,604,859**					
Oct-18	$ 2,986,321	$ 2,251,265	$ 735,056	$ 2,513,748				
Nov-18	$ 21,163	$ 1,674,739	$ (1,653,576)	$ 860,171				
Dec-18	$ 4,155,578	$ 1,732,724	$ 2,422,855	$ 3,283,026	3,283,118	(92)	Oct-18	Apr-20
Total	**$ 7,163,062**	**$ 5,658,728**	**$ 1,504,335**					
Jan-19	$ 1,920,475	$ 3,853,051	$ (1,932,576)	$ 1,350,449				
Feb-19	$ 3,155,944	$ 2,894,743	$ 261,201	$ 1,611,650				
Mar-19	$ 3,169,145	$ 3,194,968	$ (25,823)	$ 1,585,827	1,585,919	(92)	Jan-19	Jul-19
Total	**$ 8,245,563**	**$ 9,942,762**	**$ (1,697,199)**					
Apr-19	$ 5,807,168	$ 5,114,687	$ 692,481	$ 2,278,308				
May-19	$ 5,018,454	$ 4,556,144	$ 462,309	$ 2,740,617				
Jun-19	$ 4,485,738	$ 4,755,914	$ (270,176)	$ 2,470,441	2,470,533	(92)	Apr-19	Oct-19
Total	**$ 15,311,361**	**$ 14,426,746**	**$ 884,614**					
Jul-19	$ 3,769,249	$ 4,279,013	$ (509,764)	$ 1,960,677				
Aug-19	$ 4,494,930	$ 4,049,703	$ 445,227	$ 2,405,904				
Sep-19	$ 4,424,559	$ 3,591,123	$ 833,436	$ 3,239,340	2,914,800	324,540	Jul-19	Jan-20
Total	**$ 12,688,738**	**$ 11,919,839**	**$ 768,899**					
Oct-19	$ 4,836,472	$ 5,009,447	$ (172,976)	$ 3,066,365				
Nov-19	$ 2,588,487	$ 4,606,222	$ (2,017,735)	$ 1,048,630				
Dec-19	$ 5,474,263	$ 4,903,492	$ 570,772	$ 1,619,401			Oct-19	Apr-20
Total	**$ 12,899,221**	**$ 14,519,160**	**$ (1,619,939)**					

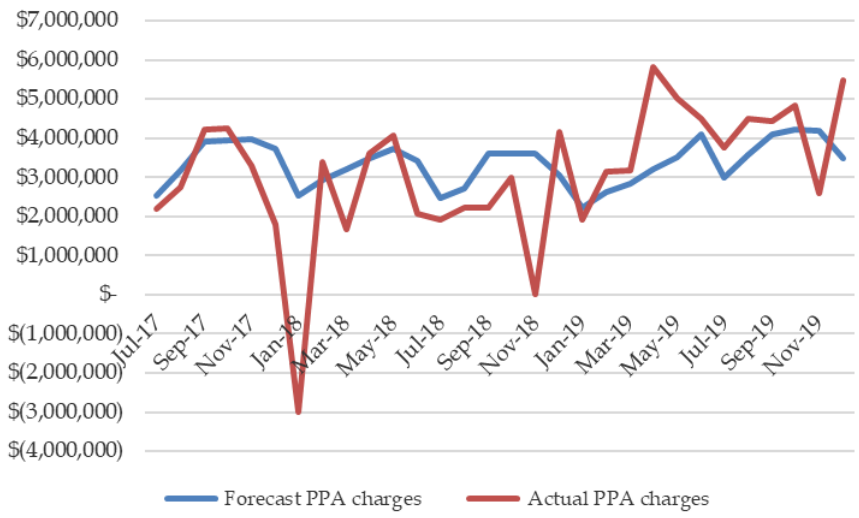
Source: LEI_1.6.4_Attachment _1, LEI_1.6.4_Attachment _2, LEI_1.6.2_Attachment_3, LEI_1.6.2_Attachment_4, LEI_1.6.2_Attachment_5, LEI_1.6.2_Attachment_6, LEI_1.6.2_Attachment_7, LEI_1.6.2_Attachment_8, LEI 1.6.2_Attachment_9, and LEI_1.6.2_Supplemental_Attachment_10; 2017 forecasts are from Ex III-7 in Vantage report.

LEI then examined whether the cumulative balance for each quarter (column D in Figure 16) corresponded to the beginning balance for each quarter as shown in the PPA Rider (column E in Figure 16). In nearly every quarter, the dollar amount was off by $92, which probably indicates a rounding error difference in the starting balance from June 2017. In Q4 2019, the company received a directive from Commission to include the final balance from its Retail Stability Rider

("RSR") of ($324,539.98) in the PPA Rider.[50] This accounts for nearly all the difference in the Schedule 3 cumulative balance calculated by LEI, and the Schedule 3 beginning balance in the PPA Rider.

The over and under-recovery in any given quarter is driven by the difference between forecast and actual PPA charges. LEI found that AEP Ohio mostly over-estimated PPA charges through 2018, but in 2019 mostly under-estimated PPA charges (see Figure 17, which is simply a graphical illustration of column A and column B in Figure 16).

Figure 17. AEP Ohio's forecast versus actual PPA charges



Source: LEI_1.6.4_Attachment _1, LEI_1.6.4_Attachment _2, LEI_1.6.2_Attachment_3, LEI_1.6.2_Attachment_4, LEI_1.6.2_Attachment_5, LEI_1.6.2_Attachment_6, LEI_1.6.2_Attachment_7, LEI_1.6.2_Attachment_8, LEI 1.6.2_Attachment_9, and LEI_1.6.2_Supplemental_Attachment_10.

4.3.5.2 Recommendations

LEI recommends shortening the time lag for true up of actual versus forecasted charges to a three-month (one billing cycle) lag, instead of the current six-month (two billing cycle) lag. The six-month lag results in delays in recovering costs which were under-charged to customers, and delays in refunding customers for over-charging. Neither the customer nor the utility benefits. A three-month period is sufficient for actual energy consumption and OVEC bills to be available to provide the needed information for true up.

4.3.6 Errors in PPA Rider

There had been some errors discovered in the previous audit, some of which were corrected by AEP Ohio and others which were not:

[50] Email dated July 7, 2020, from AEP Ohio representative Mike McCulty.

1) With respect to PPA Rider Update Q2 2018 (current version is LEI_1.6.4_attachment 2) it was noted in the previous audit that Schedules 2 and 3 had prior quarter information, not current information.[51] AEP Ohio corrected this for the current audit.

2) With respect to PPA Rider Update Q2 2018 (LEI_1.6.4_attachment 2), the title information on Schedule 3 (cell B6) was incorrect. It should have read "Forecast Jan-Mar 2018" This does not affect billing or customer rates.

3) In PPA Rider Update Q4 2018, the previous audit noted that the forecasted kWh reported on Schedule 1 was not updated to reflect the kWh shown on Schedule 2 (see Figure 18). The 11,515,199,492 kWh on Schedule 1 was the total from the previous quarter. The total from Schedule 2 was 10,264,747,633.60 (see Figure 18 again), which is the value which should have been used in Schedule 1 to compute the rate. The ratepayers were under-charged for Q4 2018 because the kWh estimate was too high. AEP Ohio did not correct this. However, Schedule 2 is an estimate, and the eventual charge to ratepayers is trued up to actuals (with a lag of six months). Therefore, the incorrect entries did not result in a permanent under-charge to customers.

Figure 18. AEP Ohio PPA Rider Update Q4 2018

OHIO POWER COMPANY
Calculation of Quarterly PPA For Billing During
October through December 2018

Schedule 1

October through December 2018							
	Residential	GS Non-Demand	Secondary	Primary	Sub/Tran	Lighting	Total
2017 5CP	3,394	132	2,097	888	1,147	-	7,658
Allocation	44%	2%	27%	12%	15%	0%	
Revenue Requirement	$ 2,414,703.50	$ 94,151	$ 1,491,657	$ 631,368	$ 816,006	$ -	$ 5,447,885
Forecasted kWh	3,802,507,750	197,073,624	2,993,354,350	1,612,033,884	2,847,819,798	62,410,067	**11,515,199,472**
Rate ($/kWh)	0.0006350	0.0004777	0.0004983	0.0003917	0.0002865	0.0000000	
Gross Up Factor	1.00938	1.00938	1.00938	1.00938	1.00938	1.00938	
Final Rate ($/kWh)	0.0006410	0.0004822	0.0005030	0.0003954	0.0002892	0.0000000	

[51] Vantage Energy Consulting LLC. *Independent audit of the Power Purchase Agreement Rider of Ohio Power Company*. January 11, 2019.P. 38.

Schedule 2

OHIO POWER COMPANY
Calculation of Quarterly PPA For Billing During
October through December 2018
FC Component

Line	Description	October	November	December	Total
	TOTAL COMPANY				
1	PPA Charge/(Credit) Forecast	$ 3,611,522	$ 3,616,187	$ 3,046,252	$ 10,273,961
	Forecast Load	**2018**			
	All kWh (non-bypassable)	**Oct-Dec**			
2	Residential	3,070,408,034			
3	GS Non-Demand	208,739,605			
4	Secondary	2,843,931,461			
5	Primary	1,460,729,911			
6	Sub/Tran	2,622,851,646			
7	Beginning Balance (Oct-Dec 20	58,086,977			
8	Total	10,264,747,634			

Source: LEI_1.6.4_Attachment 4, "Schedule 1" tab and "Schedule 2" tab

4.3.6.1 Recommendations

As in the previous audit, LEI recommends close monitoring (such as performed in the current audit) of AEP Ohio's filings for completeness and accuracy.

5 Disposition of energy and capacity

5.1 Scope and background

5.1.1 Scope

Since its integration into the PJM market in 2018, OVEC's power generation has been offered into the energy markets as a self-scheduled resource (with the exception of one unit). OVEC's generation offer practices and outcomes impact AEP Ohio's ratepayers, and therefore, are within the scope of this audit.

The chapter addresses the following subtopics:

- Organizational structure and qualifications of personnel;
- Monitoring, evaluating, and responding to developments in the PJM market; and
- Generation offers into the energy, capacity, and ancillary service markets;

In coming to LEI's conclusions, LEI issued formal data requests, talked with Company personnel over the phone, and conducted additional research.

5.1.2 Background

PJM offers four types of competitive wholesale markets where large volumes of electricity are traded. The markets are:

- **The Day-Ahead ("DA") energy market** is a forward market (one day forward) for energy and operating reserves, which are cleared simultaneously. This market allows participants to "place generation resource offers, load demand bids, physical schedules, and bilateral transactions for the next day";[52] it calculates prices by physical location.
- **The Real Time ("RT") energy market** is a spot market (five minutes) for energy and operating reserves, which are cleared simultaneously. The RT market allows participants to "place updated generation resource offers and updated load forecasts; it then provides dispatch instructions for the lowest-cost resources to satisfy system demand without overloading the transmission network and calculates prices by physical location."[53]
- **A forward capacity market, the RPM**, discussed previously. Generation resources which clear the capacity auction are required to offer power into the Energy Market for the year

[52] Understanding the Differences Between PJM's Markets. PJM Interconnection. https://learn.pjm.com/-/media/about-pjm/newsroom/fact-sheets/understanding-the-difference-between-pjms-markets-fact-sheet.ashx?la=en

[53] Ibid.

for which they are committed. They also commit to serve PJM's emergency needs whenever called upon.[54]

- **An ancillary service ("A/S") market** is operated to procure regulation and reserves to help balance the transmission system as electricity is moved from generators to end users.[55]

5.2 Evaluative criteria

LEI focused its audit of disposition of energy and capacity on answering the following questions:

1. Is the current energy scheduling department's organization and staffing adequate? Do they follow their operating procedures appropriately?
2. Does organization and staffing encourage best practices for interacting with the PJM markets?
3. Does OVEC adequately follow developments in the PJM stakeholder process?
4. Are generation resource offers prepared and submitted in the PJM markets so as to optimize utilization and revenues of OVEC's generation fleet?
5. Does OVEC have sound strategies to bid into the capacity markets?
6. Is the level of participation in the A/S market prudent?

5.3 Findings and conclusions

5.3.1 Organization and staffing

OVEC-IKEC's Energy Scheduling Department is responsible for maintaining a generation dispatch center for operation in the PJM RT market, participation in the DA market, and operational compliance. This Department operates in compliance with the North American Electric Reliability Corporation ("NERC") and the regional reliability organization's Operating Policies, keeps track of "all the latest practices and procedures with regard to energy scheduling and consistently applies standard work procedures intended to insure efficiency and economy in the operation of the department."[56]

In the Energy Scheduling Department, there is one Energy Scheduling Manager, and four senior Energy Schedulers (see Figure 19).

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[54] Understanding the Differences Between PJM's Markets. PJM Interconnection. https://learn.pjm.com/-/media/about-pjm/newsroom/fact-sheets/understanding-the-difference-between-pjms-markets-fact-sheet.ashx?la=en

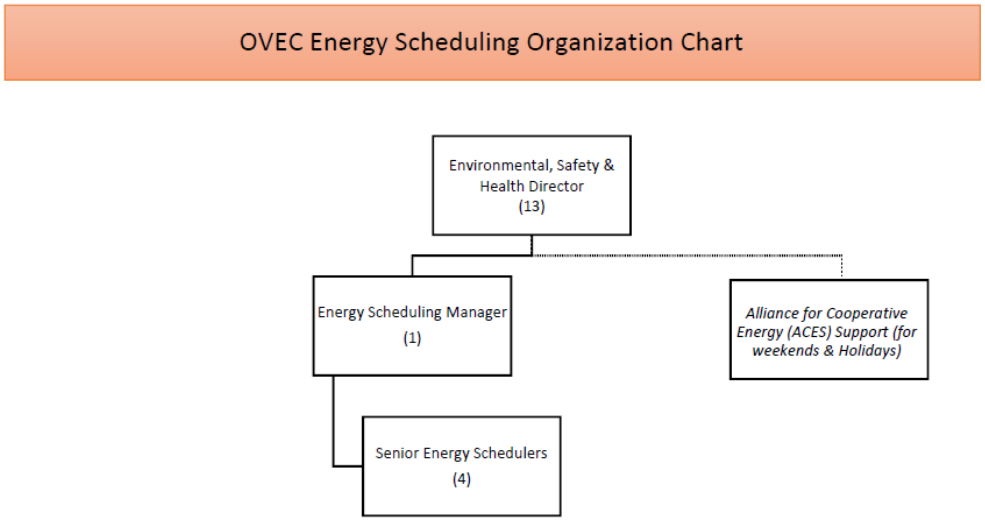
[55] PJM ancillary service. https://www.pjm.com/markets-and-operations/ancillary-services.aspx

[56] LEI-DR-8.1.2

- The Energy Scheduling Manager provides daily supervision, direction, and oversight of the Department and serves as a point of contact for Sponsoring Companies, PJM, the OVEC leadership team, and the third-party contractor that provides energy scheduling support services on weekends and holidays.
- The Energy Schedulers' duties and responsibilities include, but are not limited to: "1) determine the unit operating status and prepare and enter schedules for the sale of generation on behalf of Sponsor Companies on both a DA basis and a RT basis; 2) submit and confirm energy transaction tags using the electronic tagging system necessary to support the power transactions, and perform this function by approved backup procedures if tagging system fails; 3) receive, record, and maintain logs of normal and emergency operating conditions; 4) maintain records of generating units such as unit capabilities, unit de-rates and reasons for each de-rate, maintenance, and forced and planned unit outages; 5) request and coordinate through PJM unit outages, unit de-rates and special unit load requests for environmental testing, seasonal unit capability testing and other required unit performance testing via PJM software in a real time as well as a prospective basis; 6) prepare daily summaries of total generation and demand as required, including the requirements of NERC and the regional reliability organization."[57]
- ACES is a third-party contractor that provides energy scheduling support services during weekends and holidays.

[57] LEI-DR-8.1.2

Figure 19. OVEC Energy Scheduling Organization Chart



Source: LEI-DR-8.1.2_Attachment_1

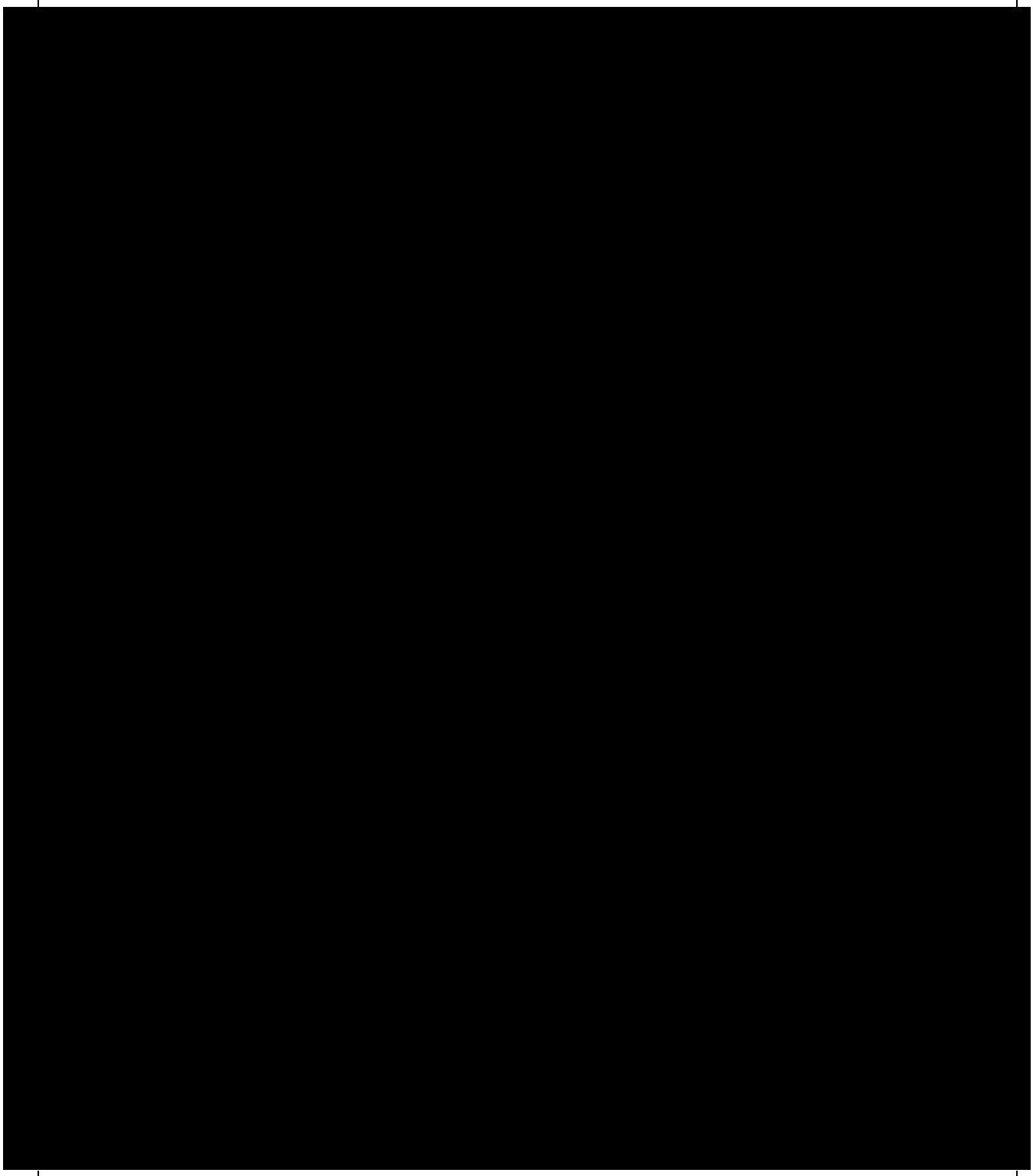
5.3.2 OVEC's processes of offering into the PJM market

OVEC's energy is to be offered in accordance with the terms of the ICPA, consistent with approved Operating Committee Procedures and PJM market requirements.

LEI understands that OVEC's Energy Scheduling department has an internal daily call every non-holiday weekday morning to review unit status and availability, including applicable unit derates, potential unit liabilities, outage status, and expected unit return-to-service dates (see Figure 20). OVEC uses this information to formulate the DA unit offers into the PJM market. Before the morning call, the Energy Scheduling department also receives a daily unit status report from each plant. The information in the report is updated based on real-time unit operating status during the morning calls. On weekends and holidays, OVEC holds a less formal daily meeting among the OVEC's system operations personnel and the contractor that provides Energy Scheduling functions.[58]

[58] LEI-DR-5.1.3

Figure 20. OVEC normal daily scheduling timeline



Source: LEI-DR-13.1.1 Confidential attachment OVEC Operating Procedures effective November 15, 2019

Initially, when OVEC became fully integrated into the PJM market in November 2018, there was no formal process whereby OVEC could evaluate prior day performance data. OVEC subsequently established a daily internal PJM Demand Comparison Report, which provides operating data that includes a unit by unit hourly comparison of actual net generation versus PJM demand, noting that "This report is made available to plant operations personnel to aid them in evaluating prior day unit and operations related performance." [59]

5.3.3 Generation offers

All of AEP Ohio's share of the energy output of the Kyger Creek and Clifty Creek power plants was sold into the PJM DA and RT markets. None was sold into the MISO market or via bilateral contract.[60]

OVEC self-schedules all but one of the units (i.e., it offers them as "must run") in accordance with the OVEC Operating Committee procedures, as approved by the Operating Committee. [redacted][61] ICPA participants, including AEP Ohio, do not have access to and cannot view hourly offer history. They only can view their respective ownership share of market awards. This ensures that competing OVEC owners are kept at arm's length.[62]

OVEC's strategy for the Kyger Creek and Clifty Creek units (except for Clifty Creek Unit 6) is to self-schedule the resource with the sponsor approved Operating Committee procedures to make sure the units are in service and expected to be available in the DA market. The only time that this is not done is when maintenance outages are planned. Unit 6 at Clifty Creek is the only unit which is not self-scheduled; it is offered based on economics during summer ozone non-attainment periods. [63]Except for outages, if a unit is available, OVEC offers it into the PJM market. Other potential exceptions could include unusual non-market related events such as coal shortages and/or some form of force majeure event out of OVEC's control.[64]

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[59] LEI-DR-5.1.3

[60] LEI-DR-1.1.1

[61] LEI-DR-13.1.1 Confidential Attachment 1. Operating Procedures effective November 15, 2019.

[62] LEI-DR-1.1.3

[63] In the summer, ozone is easily formed through the interaction with heat and sunlight, and as temperatures change throughout the day, so do the levels of ozone. The non-attainment status is based on the 3-eyar average of the 4th highest daily concentrations over an 8-hour period, as of July 31, 2019, EPA designated 51 non-attainment areas under the 2015 8-hour Ozone NAAQS, including part of Ohio and Indiana.

[64] LEI-DR-5.1.3

5.3.4 AEP Ohio's engagement in OVEC Operating Committees

The OVEC Operating Committee consists of one member from OVEC and one member from each of the Sponsoring Companies (if two or more Sponsoring Companies are affiliates, they can only have one member appointed to the Operating Committee). In support of ICPA, the Operating Committee establishes and modifies OVEC's scheduling, operating, testing and maintenance procedures, including the establishment or modification of 1) "procedures for scheduling delivery of available energy; 2) procedures for power and energy accounting; 3) procedures for the reservation and scheduling of firm and non-firm transmission service under the Tariff for the delivery of Available Power and Available Energy; (4) the Minimum Generating Unit Output; and (5) the form of notifications relating to power and energy and the price thereof."[65] Additionally, the Operating Committee provides recommendations for OVEC's Board of Directors when other problems arise which may affect the transactions under the ICPA. In order to reach a decision, OVEC Operating Committee must receive at least two-thirds of the affirmative vote from the members, regardless of the number of participating members at any meeting.[66]

AEP Ohio confirmed that OVEC Operating Committee held two in-person meetings in 2018 and 2019 (one in each year) and six conference calls (four in 2018 and two in 2019). AEP Ohio appointed representatives to participate in all the meetings (see Figure 21). Agendas were prepared for in-person meetings, while for the conference calls, due to their limited scope, there were no prepared agendas.[67]

[65] LEI-DR-1.6.1_Attachment_3

[66] Ibid.

[67] LEI-DR-13.1.3

Figure 21. AEP Ohio's participation in OVEC Operating Committees' meetings in 2018 and 2019

Meeting date	Meeting Type	AEP Representative in Attandance
26-Feb-18	Conference call	1
9-May-18	In-person	3
18-Jul-18	Conference call	4
2-Aug-18	Conference call	4
3-Dec-18	Conference call	2
15-Jan-19	Conference call	1
8-May-19	In-person	5
8-Jul-19	Conference call	1

Source: LEI-DR-13.1.3

The two in-person conferences covered a variety of topics such as fuel updates and coal strategy, participation in the PJM regulation market, environmental compliance update, power costs, and planned outage scheduling (see Figure 22). The OVEC Operating Committee's conferences served to review the operating and financial performances of OVEC as well as to discuss relevant updates in the PJM market. LEI feels AEP Ohio is well represented in OVEC Operating Committee's meetings with active engagement.

Figure 22. OVEC Operating Committee May 8, 2019 agenda

OVEC Operating Committee Meeting No. 80
8 May 2019
Christopher Conference Center – Chillicothe, OH
Agenda

I. **Administration** (Cunningham; 5 Mins.; 1000-1005)

II. **Approval of the minutes from the 10 May 2018 Meeting (No. 79) and 18 Jul 2018, 03 Dec 2018, and 15 Jan 2019 Conference Calls** (Cunningham)

III. **Subcommittee Reports - None**

IV. **Agenda Items**
- A. DOE Arranged Power Agreement Termination Update (Squibb/Brown/Chisling; 10 mins; 1005-1015)
- B. Energy Scheduling Transition Update (Squibb/Brown/Cunningham; 10 mins; 1015-1025)
- C. Subcommittee to look at ARR/FTR Options (Squibb/Chisling/ Cunningham; 15 mins; 1025-1040)
- D. Subcommittee to look at Participation in PJM Ancillary Services Market (Reactive Power, Regulation) (Cunningham; 15 mins; 1040-1055)

BREAK 15 Minutes (1055 – 1110 hrs.)

- E. Transmission Revenue (Cunningham/Chisling; 15 mins; 1110-1125)
- F. Fuel Update and Coal Strategy (Cooper/Torgerson; 15 mins; 1125-1140)
- G. Environmental Compliance Update (Brown; 15 mins; 1140-1155)
- H. Power Costs (Cooper; 15 Mins.; 1155-1210)

V. **New Business/Open Discussion** (Cunningham; 15 Mins.; 1210-1225)

VI. **Future Meeting**
- A. May 2020

VII. **Lunch** (1225-1325)

Source: LEI-13.1.1_Attachment_2.

5.3.5 OVEC's participation in the PJM stakeholder process

OVEC is a full member of PJM, and therefore has a multifaceted approach to participating and following developments in the PJM market, including attending via teleconference and/or in person various stakeholder meetings (e.g. Market Implementation Committee, Markets and Reliability Committee, Operating Committee, Planning Committee, Stakeholder Process Training, and the Tech Change Forum). In addition, multiple OVEC personnel are also subscribed to various PJM email lists associated with the stakeholder groups for additional awareness of

ongoing events and updates at PJM. OVEC Sponsors also contact OVEC to ensure that OVEC is on top of any applicable changes that may affect its operations in the PJM market.[68]

5.3.6 Capacity market

AEP Ohio, through its ownership share of OVEC, offers capacity into the PJM annual RPM auctions, for the RTO Locational Delivery Area ("LDA").[69]

In 2015 AEP Ohio PJM capacity auction (for delivery year 2018/2019), AEP Ohio offered its OVEC share as Base Product ("BP") resource[70] as well as Capacity Performance ("CP") resource.[71] [redacted]

Taking that into consideration, AEP Ohio decided to offer [redacted] incorporating [redacted]

[68] LEI-DR-8.1.1

[69] LEI-DR-5.1.2

[70] Base Capacity Resources or Base Product ("BP") are those capacity resources that are not capable of sustained, predictable operation throughout the entire Delivery Year; but are capable of providing energy and reserves during hot weather operations. The Base Capacity Resource product-type will be phased out such that only resources that meet the requirements of the Capacity Performance Resource product-type will be used to meet the PJM Region's reliability and resource adequacy needs effective with the 2020/2021 Delivery Year. Source: PJM Manual 18.

[71] Capacity Performance Resource: A generating unit, demand resource, or energy efficiency resource that has obligated itself to deliver electricity whenever PJM determines it is needed to meet power system emergencies. Source: PJM Glossary.

[72] LEI-DR-13.1.5_CONFIDENTIAL_ATTACHMENT_1

[73] Equivalent Demand Forced Outage Rate ("EFORd"): A measure of the probability that generating unit will not be available due to a forced outage or forced deratings when there is a demand on the unit to generate. Source: PJM Glossary

[74] Ibid.

[redacted]

In 2016 AEP Ohio PJM capacity auction (for delivery year 2019/2020), [redacted]

As noted previously, [redacted]

[redacted]

[redacted] (base capacity resources) and a small divisor (i.e., an assumed 30 Emergency Action hours per year). Non-Performance charge rate for CP resources = [LDA net CONE ($/MW-day) * number of days in

[redacted]

Given the risk exposure, [redacted]

Figure 23. AEP Ohio's capacity performance price ($/MW-day) and volume (MWs) offer in 2018/2019 and 2019/2020 RPM BRA auctions.

[redacted]

Source: LEI-DR-1.1.2_CONFIDENTIAL_ATTACHMENT_1

In the PJM 2018/2019 BRA, all of AEP Ohio's capacity offer cleared the market as the market clearing price was $164.77/MW-day in PJM RTO zone. In the PJM 2019/2020 BRA, all of AEP Ohio's capacity offer also cleared the market since the [redacted] offer was lower than the $100/MW-day clearing price in the PJM RTO zone.

Delivery year]/30. The RTO ICAP net CONE for the 2019/2020 delivery year is $279.55/MW-day and 365 days in the delivery year, therefore the Non-Performance charge = $279.55 * 365/30 = $3401.19. LEI-DR-8.1.3

[84] LEI-DR-1.1.2_CONFIDENTIAL_ATTACHMENT_2: AEP Ohio PJM Capacity Auction Recommendations.

[85] Ibid.

[86] Ibid.

[87] PJM Manual 18. P. 34. https://www.pjm.com/~/media/documents/manuals/m18.ashx

Figure 24. PJM RPM Base Residual Auctions ("BRA") CP results ($/MW-day)

Zone	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
RTO	$120.00	$164.77	$100.00	$76.53	$140.00

Source: PJM Interconnection 2021-2022-base-residual-auction-report.

The RPM auction is evolving as PJM continuously evaluates the markets it administers. AEP Ohio should keep monitoring developments in the capacity market.

5.3.7 Ancillary services

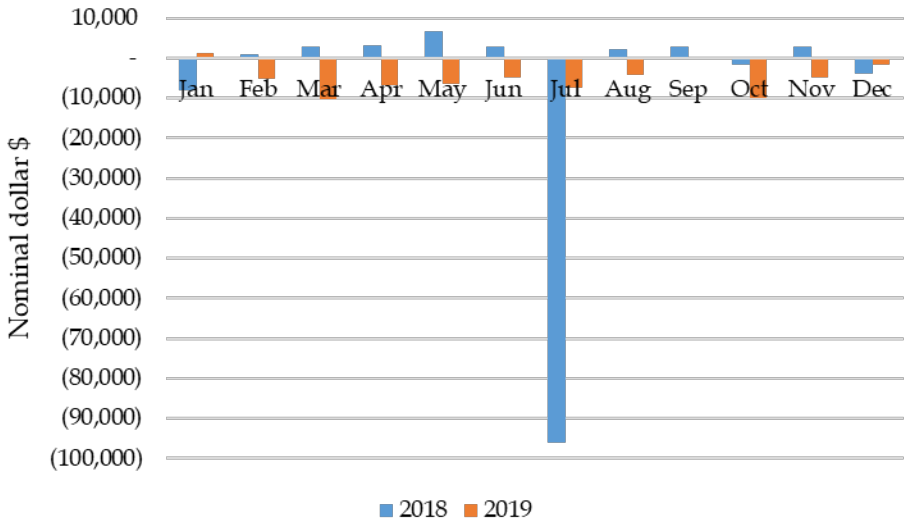
In PJM, some ancillary services ("A/S") are provided by resources by default, based on the unit being online and integrated into the PJM system. These ancillary services are the Day Ahead Scheduling and Balancing Operating Reserves.[88] Other A/S are provided in separate markets, as detailed previously in Section 3. OVEC did not participate in the organized PJM ancillary service markets during the audit period but provided other ancillary services by default (see Figure 25). In Figure 25, the July 2018 revenue is an outlier. The $96,197.86 credit is the sum of a Balancing Operating Reserve Charge of $3,476.98, a Synchronized Reserve Credit of $51.45, and a Balancing Operating Reserve Credit of $99,623.39.[89] AEP Ohio explained that the Balancing Operating Reserve Credit is attributable to two events (one on May 29, 2018 and another on May 31, 2018, both with a duration of multiple hours), in which PJM had to manually dispatch several Clifty Creek units below their market award in order to address a transmission constraint.[90] For those hours when PJM lowered their energy output, the Balancing Operating Reserve Credit compensated those units for the lost revenue.

[88] LEI-DR-5.1.4

[89] LEI-DR-14.1.1

[90] Ibid.

Figure 25. Prorated monthly AEP Ohio A/S earnings in 2018 and 2019



Note: Negative dollar amounts represent revenues and positive dollar amounts are charges.
Source: LEI 4.1.3 Attachment 1

AEP Ohio has not provided PUCO with a detailed report on the potential A/S that OVEC can provide to PJM (as recommended by Vantage Consulting in the previous audit). But AEP Ohio confirmed that OVEC is conducting a study to evaluate the potential opportunities and operational risks associated with participation in the PJM A/S market, and the study is expected to be completed by the end of 2020.[91]

5.3.8 OVEC variable costs versus energy prices

Because the OVEC plants are offered into the PJM DA market as "must run," there are times during which the PJM DA prices does not cover the variable cost of running the plants. LEI examined seven months chosen at random; on a monthly average basis, PJM prices were slightly lower than OVEC energy charges in February 2018, April 2019. August 2019, and December 2019 (see Figure 26). OVEC costs were significantly lower than PJM prices in January 2018; and somewhat lower in July 2018 and October 2018.

[91] LEI-DR-13.1.6

Figure 26. OVEC energy charges and PJM market prices



Source: LEI-DR-1.2.21 CONFIDENTIAL Attachment 1 (OVEC bill) and third-party data provider.

5.4 Recommendations

Overall, LEI finds the OVEC energy management group organization and staffing are adequate, and that procedures are thorough and well documented. OVEC has multiple channels to actively participate in the PJM market developments and is well informed of the PJM market. OVEC's offer prices in the RPM are low enough to ensure those offers clear the PJM RPM auction; the OVEC units subsequently receive the pay-as-cleared CP price, which is typically higher than their offer price.

LEI makes the following recommendations:

- **Must-run offer strategy:** LEI recommends that OVEC carefully consider when and whether the must-run offer strategy is optimal, as it appears that in some months, it may result in negative energy earnings for the plants. Weekly demand and price outlooks can be utilized, for example, to determine whether and how to offer generation during a given block of time, considering start-up costs and other factors.
- **Recommendation from previous audit**: LEI recommends that OVEC OC meetings should be held more frequently to deal with updates on each plant's operating performance, cost of serve or profit/loss statements for market-based revenues derived from the PJM markets in a timelier manner. This may help prevent plants running when energy prices are too low to cover variable costs.
- **Recommendations from previous audit:** OVEC should provide PUCO with the completed study assessing the potential participation in the ancillary services market if the plants are technically able to do so.

6 Fuel and variable costs

6.1 Coal procurement

6.1.1 Scope and background

6.1.1.1 Scope

Fuel and variable cost expenses comprise a significant portion of OVEC's costs to AEP Ohio's customers. AEP's regulated Fuel Procurement organization has the responsibility for coal procurement, coal transportation and logistics, as well as coal inventory policy and management for Kyger Creek and Clifty Creek power stations. AEP's procurement practices and outcomes related to coal impact AEP Ohio's ratepayers, and therefore, are within the scope of this audit.

This chapter addresses the following topics:

- Overview of the coal and transportation procurement processes;
- Purchasing process oversight;
- Actual coal burn and forecast;
- Overall approach to procurement and examination of sample contracts; and
- Analysis of delivered coal costs and efficiency;

In coming to LEI's conclusions, LEI issued formal data requests and conducted additional research.

6.1.1.2 Background

As described in more detail below, AEPSC is the organization which is in charge of procuring fuel, reagents, and transportation for OVEC.

OVEC's two coal plants are nearly identical in design, construction, and operation. These plants were designed to burn bituminous coal from Illinois Basin and Northern Appalachia regions, and came online in 1955-56.

6.1.2 Evaluative criteria

LEI focused its audit of coal procurement process on answering the following questions:

1. Does the coal procurement process provide for sufficient visibility and executive attention?
2. Does OVEC project future deliverability needs, and adjust its portfolio to take advantage of new opportunities or avoid looming risks?
3. Does OVEC have a strategy in place to main a reliable coal supply at a reasonable cost to customers?

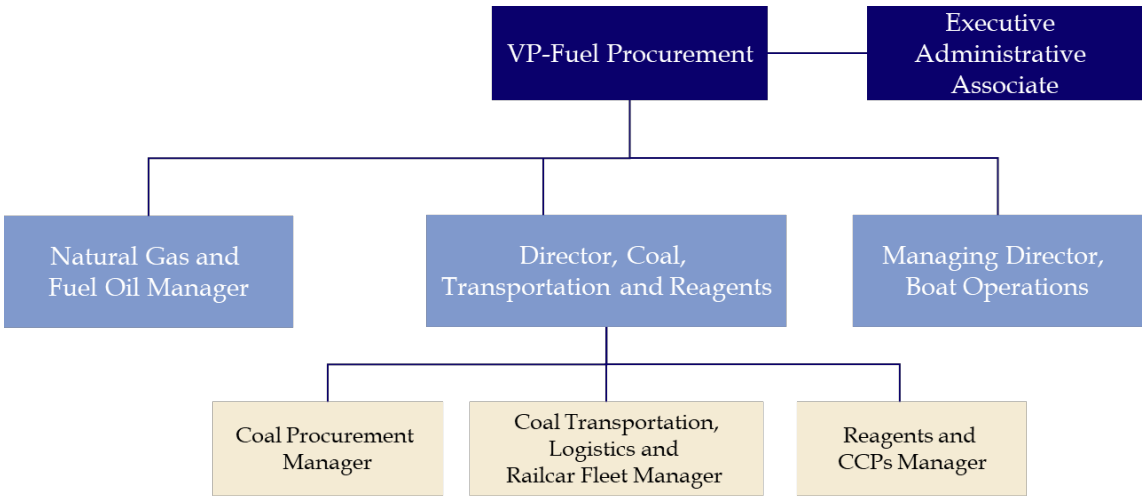
4. Does OVEC's long-term vs spot procurement strategy appropriately balance risk and costs?
5. Do contract terms reflect market awareness and prudency?
6. Is OVEC's coal procurement process conducted in an appropriately formal manner? Is there analytic rigor, oversight and management attention, and documentation of procurement decisions?
7. Were there any material issues or concerns with coal contract compliance or any disruptive events?

6.1.3 Findings and conclusions

6.1.3.1 AEP's fuel department organization

AEPSC's Regulated Fuel Procurement Policy and Procedures summarize the roles and responsibilities of the various groups within the regulated Fuel Procurement ("FP") organization as they pertain to the procurement of fuel, reagents, and transportation. The regulated FP organization operates within the Commercial Operations organization of AEPSC; it is led by a VP of fuel procurement, who reports to the Senior Vice President ("SVP") of the Commercial Operations organization of AEPSC (see Figure 27).

Figure 27. AEPSC regulated Fuel Procurement organization



Source: LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

AEPSC, as noted previously in Section 2, is a subsidiary of AEP, the parent company of AEP Ohio. AEPSC provides procurement and transportation services for the fleet of power plants owned and operated by AEP and its regulated operating companies, as well as OVEC and IKEC.

AEPSC's regulated FP department is responsible for "procuring all the fuel (coal, natural gas, and fuel oil), reagents (trona, urea, lime, limestone, activated carbon, sodium bicarbonate, anhydrous ammonia, calcium bromide) and associated transportation services required by the applicable

power plants, including the management and operation of the River Transportation Division's barges and tow boats for delivery of coal and some reagents." This organization also provides AEP's Commercial Operations organization with "current market-based pricing information for generation-related functions on behalf of the regulated operating companies, OVEC, and IKEC."[92]

The regulated FP organization "communicates with the Production Optimization and the Bid, Offer and Cost Development groups on a daily and monthly basis so that the load forecasts and fuel purchasing are effectively coordinated to make sure plants are receiving adequate supplies of fuel to meet the planned dispatch for generating units over the short-term."[93] In terms of long-term procurement planning, the regulated FP works with the groups like the Corporate Planning and Budgeting organization which is responsible for developing the Integrated Resource Plan ("IRP").[94] In addition, the regulated FP organization provides support for fuel-related regulatory activities in response to state and federal agency requirements.[95]

In the regulated FP organization, the Vice President ("VP") has the ultimate responsibility to make sure the generating stations in AEP, OVEC, and IKEC maintain appropriate and reliable supplies of fuel and reagents in compliance with generating unit requirements, environmental regulations, and transportation.

The Directors and Managers of regulated FP oversee the development, negotiation, execution, and administration of supply and transportation agreements. The Directors and Managers performing the regulated FP organization's functions report to the VP of the regulated FP. Personnel from other AEPSC departments also participate in these activities when the goals and objectives benefit AEP as a whole.[96] Under the direction of the management, the employees of the regulated FP organization attend meetings and conferences related to fuel, reagents, and transportation, and they also participate in regulatory proceedings when required. The regulated FP periodically reviews and consider changes to the regulated Fuel Procurement Policy and Procedures.[97]

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[92] Regulated Fuel Procurement Organization. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[93] Ibid.

[94] Several AEP operating company subsidiaries are required to develop periodic IRPs that are filed with state public utility commissions. However, AEP Ohio's IRP is only required under special circumstances. Source: AEP Resource Planning and Diversity.

[95] Ibid.

[96] Ibid.

[97] General administrative duties. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

6.1.3.2 Coal procurement strategy

As documented in AEP's Regulated Fuel Procurement Policy and Procedures, AEP's overall FP Policy is to "secure adequate supplies of competitively-priced coal, natural gas, reagents, fuel oil, and transportation services to meet generation, environmental, and operational requirements at the lowest reasonable deliverable cost over time, while recognizing the dynamic nature of the various associated markets, environmental standards, and regulatory requirements."[98] To achieve the strategy objectives, AEP maintains "a mix of physical inventories and a portfolio of long-term and short-term agreements for firm and discretionary supplies of fuels, reagents, and transportation for its generating units."[99]

The strategy specifies coal procurement targets for Year 1 through 5 based on OVEC management's forecast as discussed in 6.1.3.3. The coal procurement targets are reviewed by OVEC management on an annual basis (see Figure 28). [redacted].

Figure 28. Coal procurement targets

[redacted]

Source: LEI-DR-1.2.16_CONFIDENTIAL_ATTACHMENT_1: Coal Procurement Strategy: Procurement Targets, Inventory Targets and Supplier Diversity.

6.1.3.3 Coal consumption and coal forecasts

OVEC's forecast for coal burn is based on its projected generation for each of the units. The forecast looks five years out in time.[100] The coal burn forecast is prepared utilizing a variety of data, such as the cost of fuel delivered, fuel handling, variable operations and maintenance, consumable costs, scheduled maintenance outages, and forced outage factors. The coal forecast

[98] Regulated FP considerations. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[99] Ibid.

[100] LEI-DR-15.2.1

is typically updated bi-annually and could trigger the need for a Request for Proposal ("RFP") depending on inventory levels and committed purchases for the current year and future years.[101]

As discussed in 5.3.3, most of the units of Clifty Creek and Kyger Creek Power Stations are self-scheduled, so operated as baseload throughout the audit period. Both stations experienced a number of months when their actual monthly coal burned was slightly greater than their forecasted coal burn from January 2018 through December 2019, especially in 2018 (see Figure 29 and Figure 30). AEP Ohio noted that the forecast assumptions had been developed with the most recent available projections, and consumption may be higher than the forecast due to the stronger than normal pricing in the PJM market.[102]

Figure 29. Actual coal consumed versus monthly forecast estimate, Clifty Creek

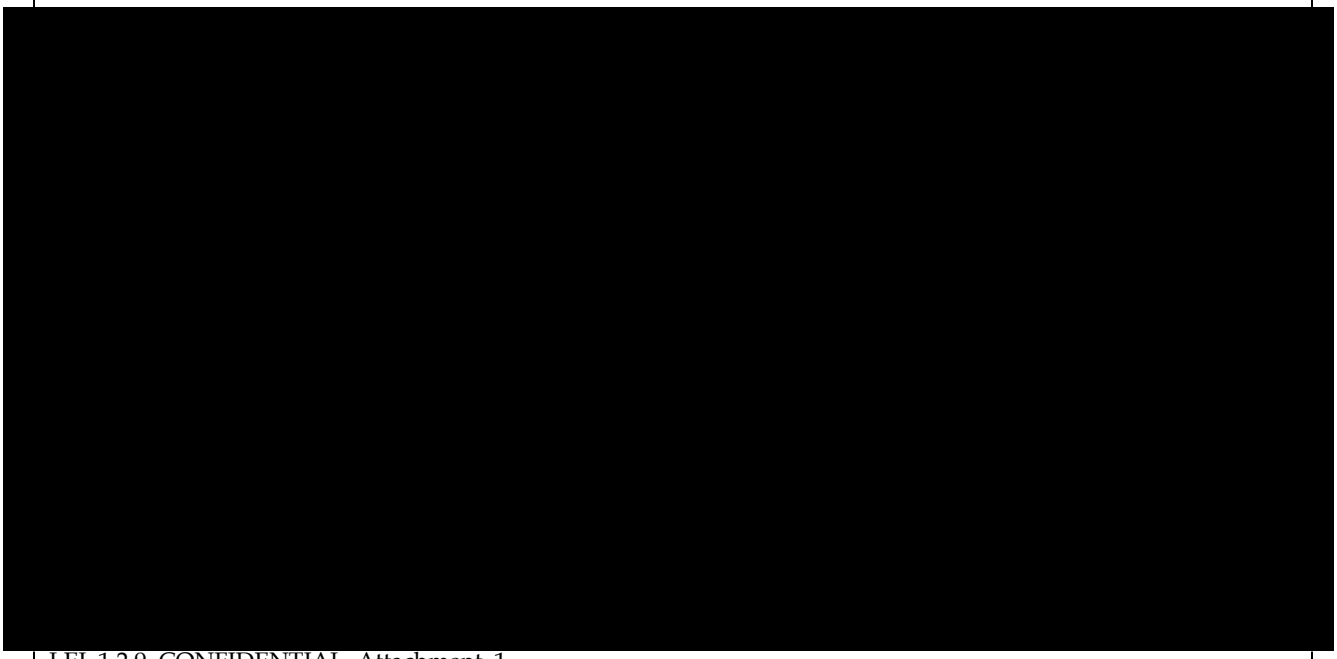


LEI_1.2.9_CONFIDENTIAL_Attachment_1

[101] LEI-DR-1.2.9

[102] LEI-DR-15.2.2

Figure 30. Actual coal consumed versus monthly forecast estimate, Kyger Creek



LEI_1.2.9_CONFIDENTIAL_Attachment_1

6.1.3.4 Request for proposals for coal supplies

With respect to coal procurement RFPs, the regulated FP stipulates that with the VP's oversight, the RFPs should be issued to seek as many competitive offers as possible to obtain the lowest reasonable delivered cost over time, but the offers should be in compliance with the state-specific requirements. Coal procurement RFPs can be issued "both for long-term contracts or spot orders whenever appropriate and can be sent to any number of qualified suppliers so as to secure the competitive price for the material or service needed."[103] All the purchase decisions made as a result of the RFPs should be documented to demonstrate that the Company acted prudently in procuring the commodity or service. During the audit period, AEP Ohio confirmed there were five RFP solicitations for coal supplies. LEI reviewed all the offers[104] received for coal procurement in five RFPs (April, August, and October 2018, and March and August 2019), and confirmed that the offer with the lowest delivered $/MMBtu was selected. LEI feels this is a prudent way to evaluate the offers and then arrive at a decision that is the most beneficial to the company.

If unsolicited offers are received for commodities or services for short or long-term agreements, the regulated FP states that these types of offers can be considered and market-based indices, other contract prices or other reasonable methods of comparison should be used to determine whether it is prudent or not to accept those offers. If any of the unsolicited offers are accepted,

[103] Request for proposal. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[104] LEI_1.2.4_CONFIDENTIAL Attachments 2, 3, 4, 5, and 6.

similar to the RFP process, documentation should be prepared to explain the rationale for the decision. LEI agrees with the practice of documenting all solicitations processes and outcomes to ensure reasonable outcomes.

If there are immediate and unavoidable circumstances for emergency procurement, "the abovementioned formal approaches may be waived whenever the fuel or reagents must be purchased, or transportation services must be acquired."[105] However, that should be the decision of the VP of the regulated FP organization, "with the concurrence of the SVP of Commercial Operations and other senior management as needed."[106] LEI understands the need for an emergency procurement process and deems it reasonable to implement given the joint decision of the VP, SVP and other senior management in the absence of the formal process. However, appropriate documentation should still be prepared after the procurement and appropriate follow-up performed in order to help prevent such emergencies from happening again, and easily locating commodity or service providers who can quickly fill in any supply or transportation gaps.

6.1.3.5 Coal supply sources

6.1.3.5.1 Supplier diversity

Based on OVEC's Coal Procurement Strategy provided in LEI-DR-1.2.16, OVEC argues that their strategy of diversifying coal providers promotes innovation, reduces supply chain risk, and drives competition. [redacted]

During the audit period, Clifty Creek had a variety of coal suppliers sourcing from [redacted] The table below shows a list of suppliers/sellers for the Clifty Creek Power Station, the amount of coal procured, and the average unit price (see Figure 31).

OVEC executed two contracts for the year 2019 with [redacted], with two different contract prices. Contract 31-10-18-005 had a contract price of [redacted] The other contract, 31-10-18-002, had a price [redacted]. The difference in the two contracts is nearly [redacted]. OVEC

[105] Emergency procurement. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[106] Ibid.

[107] LEI-DR-1.2.16_CONFIDENTIAL_ATTACHMENT_1: Coal Procurement Strategy: Procurement Targets, Inventory Targets and Supplier Diversity.

explained that these price differences resulted from contract negotiation and execution months apart, with the later contract being more expensive.[108]

The coal contract with [redacted] in 2018 and 2019, followed by the coal contract with [redacted].[109] LEI notes that even if [redacted], so less of it is needed to generate a comparable level of energy output.

Figure 31. Coal procured for Clifty Creek Station, weighted average contract price

[redacted]

Source: LEI_1.2.5_Confidential_attchment 4; LEI_1.2.5_Confidential_attchment 5; LEI_8.2.1_Attachment 1; LEI_15.2.5_Confidential_attachment_1

During the audit period, coal procured for Kyger Creek was mainly from [redacted] with another [redacted] smaller suppliers/sellers. The Figure below displays a list of suppliers/sellers for the Kyger Creek Power

[108] LEI-DR-8.2.2

[109] LEI-DR-15.2.4

Station, the amount of coal procured, and the average unit price (see Figure 32). The short-term contracts with [redacted] from January 25 through March 31, 2019, and with [redacted] from December 1, 2018 through January 31, 2019 featured much higher contract prices than the rest of the contracts. AEP Ohio aims to maintain a seasonal inventory of [redacted]. As of January 23, 2019, the inventory level at the plant was only approximately [redacted] of Eastern coal due to higher than forecasted consumption, so AEP Ohio took delivery of high-priced coal to build up its inventory.[110]

Figure 32. Coal procured for Kyger Creek Station, weighted average contract price



Source:
LEI_1.2.5_Confidential_attchment 2; LEI_1.2.5_Confidential_attchment 3; LEI_1.2.5_Confidential_attchment 5; LEI_15.2.5_Confidential_attachment_1

6.1.3.6 Coal spot price comparison

To assess the reasonableness of coal purchase prices made during the audit period, based on the coal contracts provided by AEP Ohio, LEI compared the weighted average coal supply prices in 2018 and 2019 for Clifty Creek and Kyger Creek against the spot prices [redacted]

[110] LEI-DR-15.2.3

Figure 33. Weighted average coal contract price versus SNL Physical Market Survey price for Clifty Creek plant



Figure 34. Weighted average coal contract price versus SNL Physical Market Survey price for Kyger Creek plant



LEI found that for Clifty Creek plant, the coal purchase prices were about higher than the spot prices from SNL. The high average price is mainly attributable to the expensive coal purchased from which accounted for more than of the total supply in each year. As previously mentioned, OVEC accepted to pay the higher prices to compensate the coal delivered to the power plant which had a better quality and higher heating value than the contractual requirements. However, OVEC was able to secure coal purchases at competitive

prices for Kyger Creek plant with coal contract price lower or less than [redacted] higher than the SNL Physical Markets Survey prices. [redacted] is the largest coal supplier that provided more than [redacted] of the coal consumed by Kyger Creek, and the contract prices between [redacted] and OVEC seem to be a very good deal.

6.1.3.6.1 Interruption or loss of supply

This emergency strategy pertains to suppliers that make up greater than [redacted] of the plant's supply of coal with an interruption of supply greater than four weeks. OVEC has a very clear flow chart that covers what to report, and to whom, in the event that loss of supply, in order to minimize losses and maintain regular operations (see Figure 35). AEP Ohio noted that OVEC has not ever had to utilize this process.[111]

Figure 35. Communication of event

[redacted]

[111] LEI-DR-8.2.3.

6.1.3.7 Hedging policy

The regulated FP states the regulated FP organization may enter into fuel hedges to support AEP's key business objectives and reduce fuel price volatility. The primary means to do so is through a portfolio of physical supply agreements of various durations. They believe this "portfolio ensures less volatile fuel prices, and it also allows some flexibility to leverage shorter-term pricing options when they become available."[112]

Currently, the AEP Ohio reports that the regulated FP group is not engaged in any financial fuel hedge transactions because of the possible gains, losses, and associated costs. But they do not discard the option of evaluating hedging opportunities that may be settled financially. The implementation of specific operating company hedging programs will be subject to the appropriate regulatory approvals and cost recovery mechanisms.[113] AEP Ohio confirmed that the hedging policy has not changed from the May 2018 Regulated Fuel Procurement Policy and Procedures, and there are currently no financial hedges in place.[114]

6.1.3.8 Coal and reagent quality specifications and compliance

AEP's Steam Generation Equipment Engineering ("SGEE") group defines the permissible coal specifications and sources for AEP's regulated operating companies' plants as well as OVEC's and IKEC's plants.[115] These specifications and sources are utilized by the regulated FP organization to evaluate the coal offers from suppliers. "When the offers' evaluation is within the qualify specification band, coal quality specifications are considered and financial adjustments are made to provide a comparison at "as delivered" cents per MMBtu cost and acceptable mines will be included in the coal supply contracts."[116] Periodically, new sources are considered through test burns to diversify the coal choice for each unit, which may lead to more favorable financial results. But new sources must be approved by SGEE before moving forward beyond the test burns.

The "permissible reagent specifications and sources for AEP's regulated operating companies' plants, as well as OVEC's and IKEC's plants, are established by an independent firm known as GET Engineering FGD Systems and Chemical Engineering."[117] A number of parameters such as

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[112] Hedging policy. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018

[113] Ibid.

[114] LEI-DR-13.2.1

[115] Coal and reagent quality specifications and compliance. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018

[116] Ibid.

[117] Ibid.

performance guarantees, profitability, service quality, past experience, are taken into account in the reagent proposals.

6.1.3.9 Coal contracts administration

The Energy Contracts and Confirmations group under Enterprise and Credit Risk Management of AEP administers the existing and proposed contractual agreements for the purchase and sale of coal, fuel oil, natural gas, reagents, transportation agreements, and ash marketing for AEP's regulated operating companies and OVEC and IKEC. [118] This group works with regulated FP Directors and Managers, Legal, Credit, Fuel Accounting, Audits, Regulatory Services, and power plant personnel to make sure that contracts appropriately represent the intended business relationship between the parties. They are also responsible for monitoring the regulated operating companies' rights and obligations under the existing contractual agreements.

The support services from contract administration include the following:[119]

- "Developing and/or reviewing contractual documents under existing and proposed agreements;"
- "Monitoring contractual deadlines with regard to volume elections, price reopeners, and term extension elections; issuing written notices to counterparties to inform regulated FP decisions;"
- "Determining contract value through pricing and rate development;"
- "Providing contractual review, such as analysis of proposed settlements, changes in law, governmental impositions, and other pricing claims;"
- "Managing data requirements for internal fuel administration systems which provide database of historical costs and volumes for invoice support and reporting requirements;"
- "Monitoring and reporting volume commitment status and tiered pricing under transportation agreements; "
- "Administering coal scale calibration adjustments including determination of any applicable pricing adjustments;"
- "Providing coal, reagent, fuel oil, natural gas, and transportation contract data for state and federal regulatory filing's purpose;"
- "Administering Force Majeure claims initiated by the regulated FP or counter parties;" and
- "Providing accrual recommendations to the group responsible for fuel accounting."

6.1.3.10 Coal transportation and transportation costs

AEP's regulated FP governs the coal transportation service procurement process to achieve compliance by the supplier and maintain adequate supplies of fuel and reagents to meet plant

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[118] Contract administration. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018

[119] Ibid.

and system requirements.[120] The Coal Transportation, Logistics and Marketing group is responsible for the transportation of coal and other bulk commodities, logistics, and railcar leasing for the regulated AEP operating companies, OVEC's and IKEC's power plants. They also manage the marketing activities of available capacity at Cook Coal Terminal. The Boat Operations group bears the responsibility for the management and operation of the River Transportation Division's barges and tow boats for delivery of coal to the coal fired generation, plants and the delivery of some reagents. They have a contractual relationship with a large third-party barge operator for dispatching of the fleet, accounting, as well as cross-charter benefits.[121]

As discussed in 6.1.3.2, AEP's procurement strategy for transportation service is to "provide an appropriate amount of transportation with optimal supply flexibility, considering AEP's long-term agreements and market conditions, at the lowest reasonable delivered cost over time."[122] The transportation service is "purchased with due consideration of all relevant factors, including: competitive pricing, the quantity needed to maintain an appropriate supply, the quality required to optimize the operating characteristics of the generating stations, the need to meet any applicable environmental standards, the production capability as well as the financial reliability of the supplier, existing contractual obligations, and the ability to address emergencies or other unusual circumstances."[123]

All the coal used by the Clifty Creek plant is delivered on the Ohio River, and all via barge transportation services provided by Ingram Barge Company with coal supplies from downriver (south of the plant). [124]

All the coal used by the Kyger Creek plant is also delivered via barge on the Ohio River, but the service provider is Campbell Barge Company. Coal supplies for Kyger Creek are sourced from upriver (north of the plant).[125]

The transportation service cost represents the shipping cost per ton of coal from various shipping locations along navigable waterways. Additionally, [redacted]. both occasionally transported coal to Clifty Creek and Kyger Creek from September to December, 2018 (see Figure 36).

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[120] Enforcement of agreements. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[121] Organizational structure of regulated FP. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[122] Regulated FP considerations. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[123] Ibid.

[124] LEI-DR-1.2.14

[125] Ibid.

Figure 36. Coal transportation contracts summary



Source:
LEI 1.2.15 CONFIDENTIAL Attachment 1 for the Campbell Transportation Company rates for 2018 and 2019 and LEI 1.2.15 CONFIDENTIAL Attachment 2 for the Ingram Barge Company rates for 2018 and 2019.

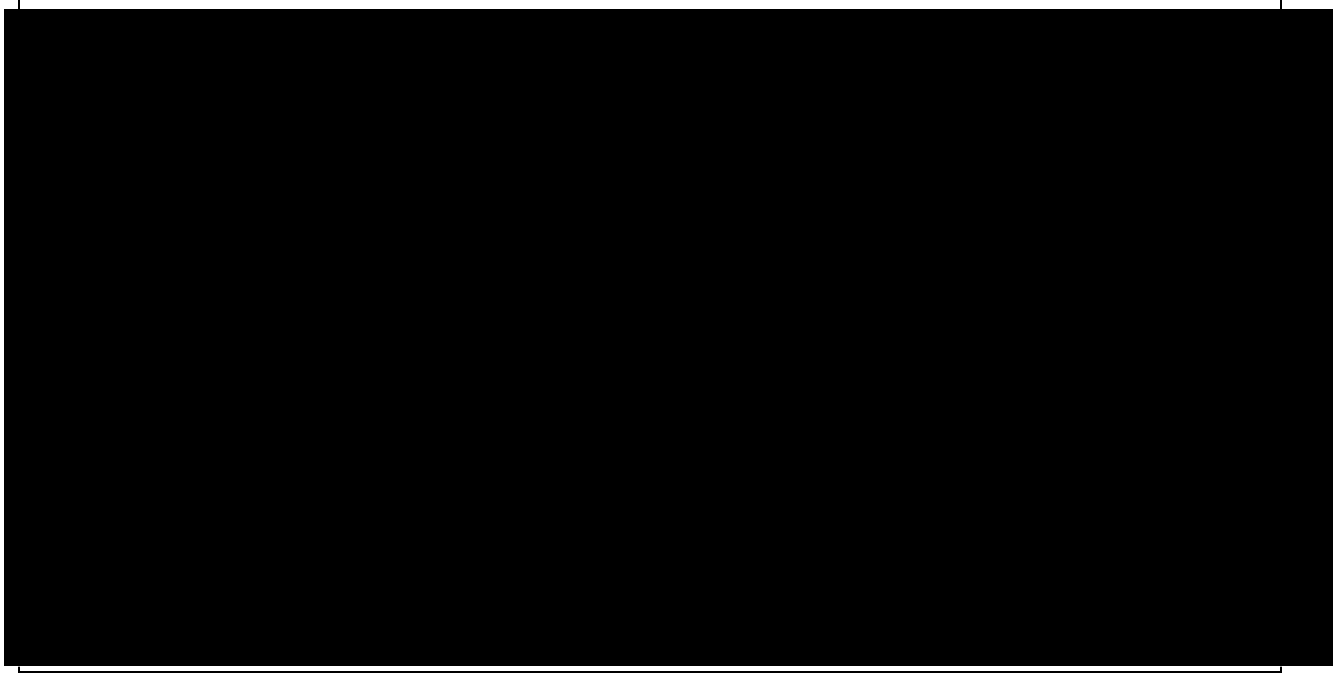
LEI compared OVEC's transportation costs of Clifty Creek and Kyger Creek Stations to the Energy Information Administration ("EIA") average annual coal transportation costs using the EIA data set "Coal Basin to State by Waterway." Given the limited publicly available data, for Kyger Creek Plant, LEI compared the actual annual average coal transportation cost from Northern Appalachia to Ohio via barge in 2018 and 2019 (see Figure 37), and for Clifty Creek Plant, the comparison was conducted on the average coal transportation costs in Illinois Basin from 2018 to 2019.[126] See Figure 37 and Figure 38 for Kyger Creek and Clifty Creek Stations costs compared to EIA transportation costs. In 2018, both Kyger Creek's and Clifty Creek's transportation costs were lower than the EIA benchmark; while in 2019, the transportation costs incurred by both plants were slightly higher than the EIA preliminary data, but were within a reasonable range. LEI feels that by and large, OVEC was able to secure competitive transportation costs to ship coal via barge to the two coal-fired power plants.

[126] Coal transportation costs from Illinois Basin to Indiana by waterway is withheld to avoid disclosure of individual company data in EIA website.

Figure 37. Kyger Creek plant coal transportation cost compared to EIA



Figure 38. Clifty Creek plant coal transportation cost compared to EIA



6.1.3.11 Additional costs

In addition to coal commodity and transportation, additional activities and costs are needed in procuring and managing coal inventory for Kyger Creek and Clifty Creek stations. The reagent costs associated with pollution control facilities and allowances are the main variable costs

incurred by OVEC to control emissions and comply with environmental regulations. The reagents used in this audit period included trona, urea, and limestone.[127]

Historically, OVEC purchased and managed emissions allowances to comply with applicable environmental requirements under both the state and federal implementation plans limiting NO_x and SO_2 emissions. During the audit period, the only allowance costs were from ozone allowances that had been purchased in 2017 which were charged to Sponsors during the audit period.[128] No other emission allowances were purchased. OVEC also confirmed that they do not expect to purchase additional SO_2 allowances in the near future.[129]

The reagent cost was consistently higher from January to July in 2018 than in 2019, but the allowances costs allocated to Sponsors consistently decreased from 2018 to 2019 (see Figure 39).

Figure 39. OVEC reagent costs and allowance cost comparison



Source: LEI_1.2.21_Confidential_attchment 1.

6.1.4 Recommendations

Coal contract terms seem reasonable in terms of compliance with the coal procurement target strategy. Coal transaction in long- and short-term allowed for some volume flexibility. LEI feels the overall coal contracts reflected market awareness and prudency. AEP confirmed that during the audit period, no fuel procurement audits were conducted.[130]

[127] LEI-DR-15.2.7

[128] Ibid.

[129] LEI-DR-3.4.2

[130] LEI-13.2.2

LEI makes the following recommendations:

- As illustrated in Figure 29 and Figure 30, the coal burn forecasts were significantly different from the actual burns. LEI recommends OVEC re-examine the process that creates these forecasts and conduct the forecast more frequently to reduce the discrepancies between the actual and estimated coal burns in the following periods.
- The coal contract prices for Clifty Creek plant were a bit higher because of the quality improvement at the delivery point, LEI recommends OVEC negotiate with the coal suppliers to ensure the delivery of coal with good quality but at more competitive prices.
- Since during the audit period there was no fuel procurement audit, LEI recommends OVEC conduct an internal audit each year to enhance their coal procurement management.

6.2 Coal inventory management

6.2.1 Scope and background

6.2.1.1 Scope

The regulated FP organization within AEP has the responsibility for coal inventory policy and management of the coal serving the Kyger Creek and Clifty Creek power stations. AEP's procurement practices and outcomes related to coal impact AEP Ohio's ratepayers, and are within the scope of this audit.

This chapter addresses the following topics:

- Overview of the coal inventory policy;
- Coal inventory control and outcomes; and
- Analysis of coal inventory costs and efficiency.

In coming to LEI's conclusions, LEI issued formal data requests and conducted additional research.

6.2.1.2 Background

Coal inventory management is an important part of reliably and optimally operating OVEC's coal power generation. Coal inventory adds protection against coal supplier default or delays in coal transportation. According to the regulated FP, it ensures "the availability of an adequate, reliable supply of fuel (and reagents) at the lowest reasonable delivered cost for the generation of

electricity."[131] Therefore, an appropriate amount and quantity of coal is supposed to be maintained and used properly at the facility.

6.2.2 Evaluative criteria

LEI focused its audit of coal procurement process on answering the following questions:

1. Does the coal inventory policy in place provide for sufficient visibility and executive attention?
2. Did OVEC maintain an appropriate inventory level in compliance with Coal Inventory Policy to avoid excessive inventory surpluses or shortfalls by actively managing transportation capacity and commodity contracts?
3. Are ratepayers carrying too much inventory?

6.2.3 Findings and conclusions

6.2.3.1 Coal inventory policy

The regulated FP states that a cross-functional team recommends a fuel inventory target, which is subject to the approval of senior management. The inventory target determination process helps to ensure that each plant's needs are met.[132]

During the audit period, OVEC considered the following factors when setting inventory targets: shipment distance to plant, lock risks, river conditions (i.e., water level or presence of ice), full load dispatch around the clock, maintenance/outage to plant and/or coal yard equipment (see Figure 40).

[131] Proper inventory levels. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[132] Proper inventory levels. LEI_1.2.1_Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

Figure 40. Coal inventory targets

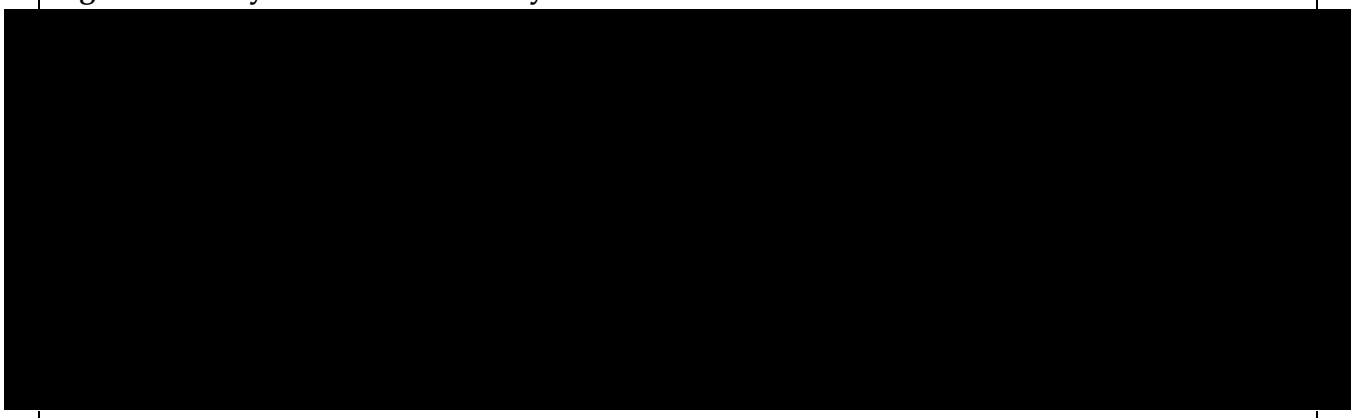


The full load is related to the units' summer and winter seasonal capability. Spring/summer capability is usually lower than winter by a few MW because of higher river temperatures, because warm river water does not cool the plants as efficiently. The fall/winter season full load inventory level of each power plant is higher than their spring/summer level.

6.2.3.2 Inventory control

Coal inventory levels at Clifty Creek averaged about [redacted] in 2018 and [redacted] in 2019 (see Figure 41). The 2019 inventory levels significantly exceeded OVEC's recommended seasonal inventory of [redacted] for the fall and winter seasons, and [redacted] for the spring and summer seasons. [133]

Figure 41. Clifty Creek coal inventory level



Source: LEI_1.2.7_CONFIDENTIAL_Attachment_1

[133] LEI_1.2.7_CONFIDENTIAL_Attachment_1

In 2019, the monthly net generation and capacity factor for Clifty Creek was consistently lower than its 2018 level except for March and October. This may have resulted in a less accurate coal burn forecast, thus making the "days on hand" inventory level significantly above the target (see Figure 42).

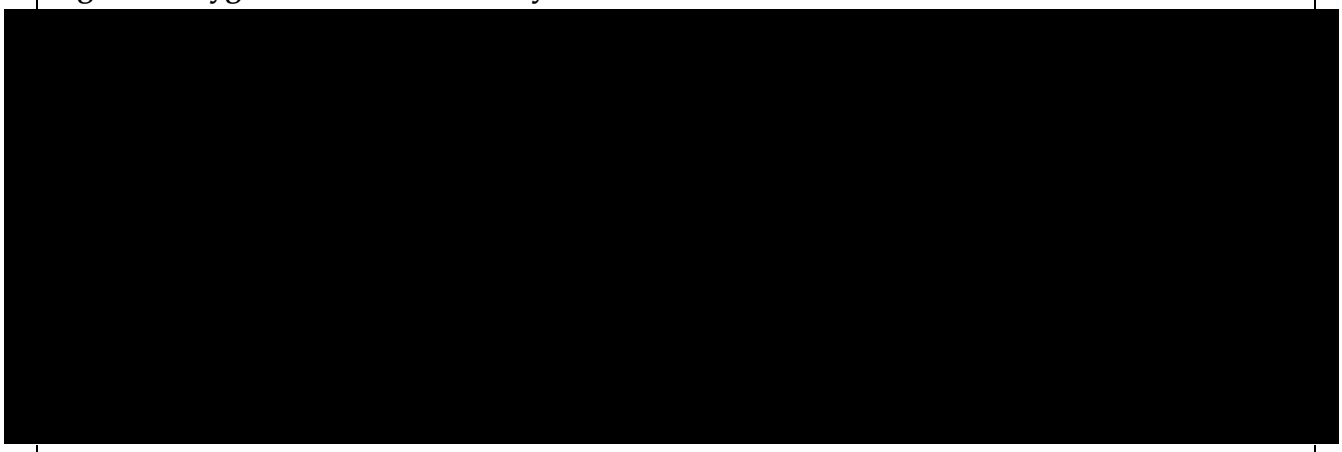
Figure 42. Clifty Creek historical generation and capacity factor



Source: LEI_1.5.5_Confidential_Attachment_2;

Kyger Creek's inventory level averaged about 33 days in 2018 and 80 days in 2019 (see Figure 43). Similar to Clifty Creek, its 2019 level was significantly higher than OVEC's recommended seasonal inventory of 40 days for the fall and winter seasons, and 30 days for the spring and summer seasons.

Figure 43. Kyger Creek coal inventory level



Source: LEI_1.2.7_CONFIDENTIAL_Attachment_2

The monthly net generation and capacity factor in Kyger Creek was higher in 2019 than in 2018 for half of the year (six months), and lower for the other half (see Figure 44). However, in those

months when the generation and CF was higher in 2019 than 2018, the number of days of coal on hand was still significantly above the inventory target. That inventory is not consistent with targets may be a result of inaccurate coal burn forecasts or management may have taken delivery of coal which was known not to be needed, but which the organization was contractually obligated to take.

Figure 44. Kyger Creek historical generation and capacity factor



Source: LEI_1.5.5_Confidential_Attachment_2;

6.2.4 Recommendations

Coal inventory levels were generally in 2018 were more or less in line with targets, but in 2019, the inventory levels in both power plants were substantially higher than the inventory targets.

- LEI recommends that OVEC improve its inventory management processes;
- The actual quantities of coal burned at Kyger Creek and Clifty Creek were significantly different from the coal burn forecast. More accurate outlooks for coal burns and tighter inventory controls could reduce the inventory surplus and thereby reduce inventory costs to OVEC ratepayers. LEI recommends OVEC re-examine the process it uses to create coal burn outlooks, and its policy on taking deliveries of coal.

7 Environmental compliance

7.1 Scope and background

7.1.1 Scope

OVEC's environmental compliance activities are within the scope of this audit, as the Commission has specifically asked for this analysis.

This chapter addresses the following topics:

- Overview of Ohio's air regulations and renewable energy targets;
- Organizational structure and qualifications of personnel;
- Current status of OVEC's environmental control;
- OVEC's emissions allowance management; and
- OVEC's preparation for compliance with proposed or newly enacted environmental regulations;

In coming to LEI's conclusions, LEI issued formal data requests, attended an on-line virtual plant site visit with Company personnel, and conducted additional research.

7.1.2 Background of Ohio's air regulations

7.1.2.1 Air regulations in Ohio

On March 10, 2005, the United States Environmental Protection Agency ("EPA") issued the Clean Air Interstate Rule ("CAIR") that required significant reductions of SO_2 and NOx emissions from coal-burning power plants. On March 15, 2005, the EPA also issued the Clean Air Mercury Rule ("CAMR") that required significant mercury emission reductions for coal-burning power plants. These emission reductions were required in two phases: 2009 and 2015 for NOx; 2010 and 2015 for SO_2; and 2010 and 2018 for mercury. Ohio subsequently finalized its state-level versions of CAIR and CAMR. In response, the OVEC shareholders determined that it would be necessary to install flue gas desulfurization ("FGD") systems at both coal plants to comply with these rules.

After the promulgation of CAIR and CAMR, a series of legal challenges to those rules resulted in their replacement. CAMR was replaced with the Mercury and Air Toxics Standards ("MATS") rule which became effective on April 16, 2012. The OVEC plants were required to demonstrate compliance with MATS emission limits by April 16, 2015. On August 8, 2011, the EPA promulgated the Cross-State Air Pollution Rule ("CSAPR") and subsequently, a CSAPR Update rule became final on September 7, 2016, and went into effect beginning with the May 1, 2017 to September 30, 2017 ozone season. The CSAPR Update did not replace CSAPR, it only required additional reductions in NOx emissions from utilities in twenty-two states, including Ohio, during the ozone season.

7.1.2.2 Solids regulation in Ohio

Solid emissions (fly ash, boiler slag, and FGD gypsum) from coal plants are regulated under EPA's Coal Combustion Residuals ("CCR") rule, which went into effect in October 2015. As noted in OVEC's 2019 annual report *"[t]he US EPA elected to regulate CCR as a non-hazardous waste…The rule applies to new and existing CCR landfills and CCR surface impoundments…The rule is self-implementing and currently does not require state action*."[134]

7.2 Evaluative criteria

LEI focused its audit of environmental compliance activities on answering the following questions:

1. Is the current environmental department's organization and staffing adequate?
2. Has OVEC appropriately responded to environmental regulations relevant to the plants? Has this impacted fuel procurement, in terms of type and cost of fuel purchased?
3. Has OVEC ensured a rigorous emission allowance management strategy for the coal plants? What methods does OVEC use to analyze environmental compliance options and strategies?
4. Has OVEC appropriately monitored, evaluated, and responded to the environmental compliance options?
5. What is the overall emission allowance management strategy, including any emission allowance transactions in which OVEC participated?

7.3 Findings and conclusions

7.3.1 Organization and staffing

The Environmental, Safety, and Health Department ("ESH") of OVEC-IKEC is responsible for managing and directing environmental compliance activities to make sure OVEC-IKEC is fully compliant with new and existing federal, state, and local environmental laws and regulations. The ESH Department also works closely with System Office management, plant management, personnel from the environmental service and engineering of Sponsor Companies, as well as their environmental departments to effectively carry out environmental compliance activities.[135]

The ESH Department consists of 13 staff (see Figure 45), and their duties and responsibilities include:[136]

- "Developing and administering programs and policies to ensure the Company is operating in full compliance with all applicable regulatory requirements;"

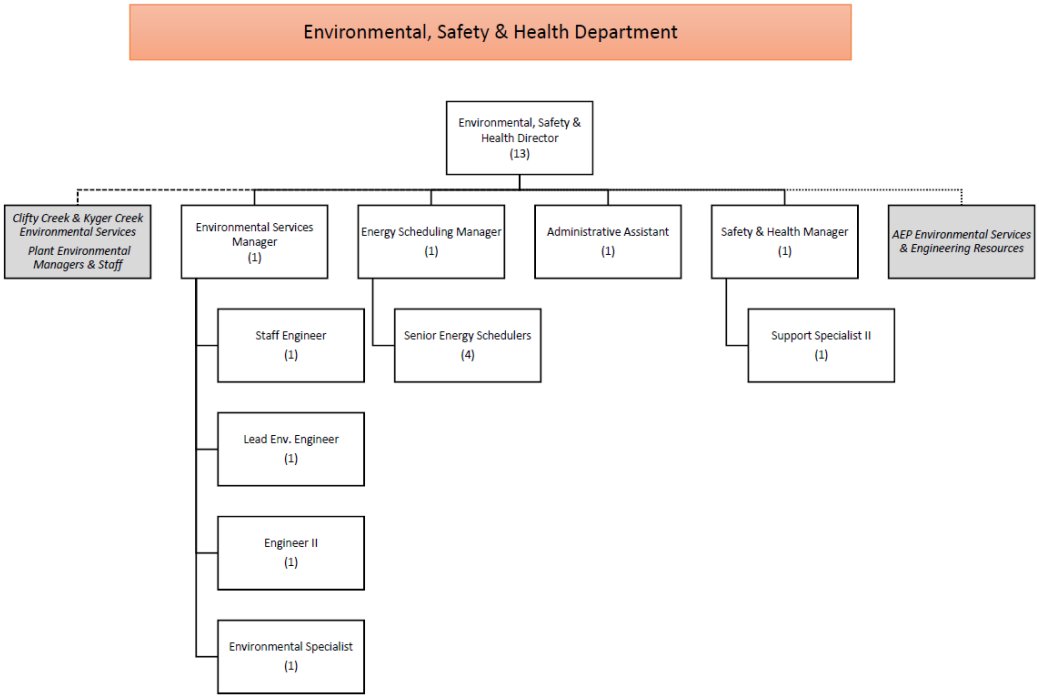
[134] OVEC Annual Report 2019.

[135] LEI-DR-1.4.1

[136] Ibid.

- "Staying current with all new legal precedence and technology developments relating to environmental compliance with Company operations;"
- "Securing and renewing all federal and state air, water, and solid waste permits required to meet applicable compliance obligations at all company facilities;"
- "Maintaining relationships with federal, state, and local environmental regulatory agencies for the purpose of obtaining guidance, required construction and operating permits and other necessary approvals in a timely manner, and for the purpose of resolving any compliance matters in the most efficient and amicable way possible;"
- "Working with outside legal counsel, consultants, and contractors for the purpose of resolving legal issues, conducting studies, and implementing projects to ensure the Company is operating in full compliance with all applicable regulatory requirements;" and
- "Managing emission allowance compliance activities for the Acid Rain Program, CSAPR and CSAPR Update rules."

Figure 45. OVEC-IKEC ESH Department Organization Chart



Source: LEI-DR-1.4.1_Attachment 1

7.3.2 Current environmental control status of OVEC

Over the course of its operation, OVEC has installed and retrofitted a variety of equipment and systems in both Kyger Creek and Clifty Creek Power Plants so as to comply with the environmental laws and regulations at the federal, state, and local levels.

The current installed environmental controls and monitors for both plants are the following:[137]

- **Electrostatic precipitator:** this is part of the emission control system to mitigate air pollution. In the 1970s, the electrostatic precipitators were required to be installed along with newer flue gas stacks at all 11 units of the power stations in light of the 1970 Clean Air Act ("CAA"). The electrostatic precipitators are simple to use, with a collective efficiency of over 99%, they efficiently remove small particles of ash and SO_3 using reduced velocity and an electric charge. The fly ash is also removed during the combustion process prior to flue gas exiting through the stack at the power plant.
- **Overfire air system:** to meet the emission requirements for NOx, overfire air systems were put in place in the 1990s at all 11 units, to meet the requirements of the Acid Rain Program as part of the 1990 Clean Air Act Amendment. The overfire air system effectively reduces NOx emissions by 50%.
- **Selective catalytic recovery ("SCR") system**: SCR equipment was retrofitted and installed in 2002 and 2003 to meet additional NOx reduction requirements applicable to the utilities ozone season cap and trade program under the US EPA's NOx State Implementation Plan Call Rule. SCRs are used to convert NOx in the furnace exhaust gas into N_2, H_2O and CO_2. Each unit in OVEC has installed one SCR except for Clifty Creek Unit 6 which is not self-scheduled, but offered based on economics during summer ozone season (see Figure 46 and Figure 47). "Since the current NOx regulations allow "bubbling" of the emissions from both Clifty and Kyger and since OVEC chose to design the reactors for a NOx removal efficiency of 90%, sufficient margin exited to allow one unit to remain uncontrolled."[138] OVEC notes that the installation of ten SCRs has turned out to be an efficient and economically cost-effective way to meet the CSAPR rule.
- **Jet bubbling reactor ("JBR") and scrubber system:** JBR scrubbers system were installed between 2011 and 2013 on the flue gas outlets of the plant (in total four, two at each plant) to reduce SO_2 emissions from the fuel used at each plant by up to 98%. The scrubber installations also accelerated other equipment installation, for example, new landfills were built to manage the disposal of coal combustion byproducts, and new physical/chemical wastewater treatment systems were installed to treat the residual wastewater generated from the JBR scrubber chlorides purge streams. Additionally, JBR design and proper operation brings co-benefits of lower particulate matter and mercury emissions to comply with EPA's MATS without additional need for capital expenditure in pollution control.
- **Flue gas desulfurization ("FGD") system:** FGD systems were completed in 2012 and 2013 in Kyger Creek and Clifty Creek. FGD systems at each plant included two JBRs, a new stack with two flues (one for each JBR), a FGD waste water treatment plant ("WWTP"), a limestone barge unloader, limestone preparation and storage, gypsum dewatering, and a trona dry sorbent injection system for SO_3 mitigation. JBR – 12 from Kyger Creek scrubs flue gas from Units 1 and 2, and JBR – 35 of the plant scrubs Units 3, 4, and 5. Clifty Creek's JBR – 13 is used to scrub Units 1, 2, and 3, and JBR – 46 serves to scrub Units 4, 5, and 6.

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[137] LEI-DR-10.4.1_Attachment_1, LEI_DR-16.4.1, and oral presentation from OVEC staff during the virtual plant site visit on August 6, 2020.

[138] Technical review for Kyger Creek and Clifty Creek in July, 2011.

- **Continuous emissions monitoring system ("CEMS"):** primary and redundant backup systems were installed on each new flue when the scrubbers were placed into service. CEMS continuously monitors the CO_2, NOx, SO_2, PM 10 and PM 2.5, mercury and flue gas volumetric flowrates. CEMS output is processed through a data acquisition system to enable OVEC to provide quarterly emissions data to US EPA and other federal or state environmental organizations to demonstrate compliance. The NOx, CO_2, SO_2, flow monitors were installed to meet EPA reporting requirements. The Mercury and Particulate Matter monitoring systems were installed per US EPA regulations to meet MATS compliance. OVEC staff manage air pollution control in real time to make sure the emissions do not exceed the US EPA limit.

Figure 46. Clifty Creek air pollution control process

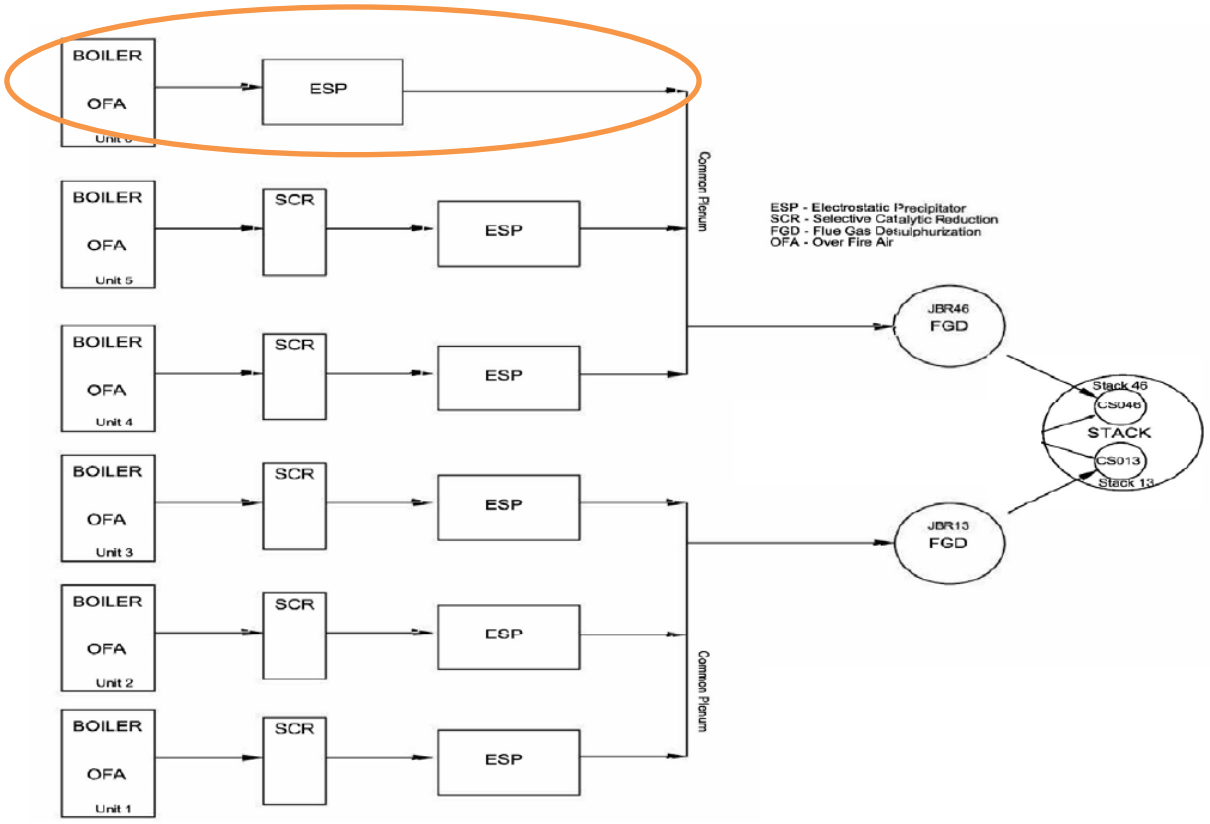
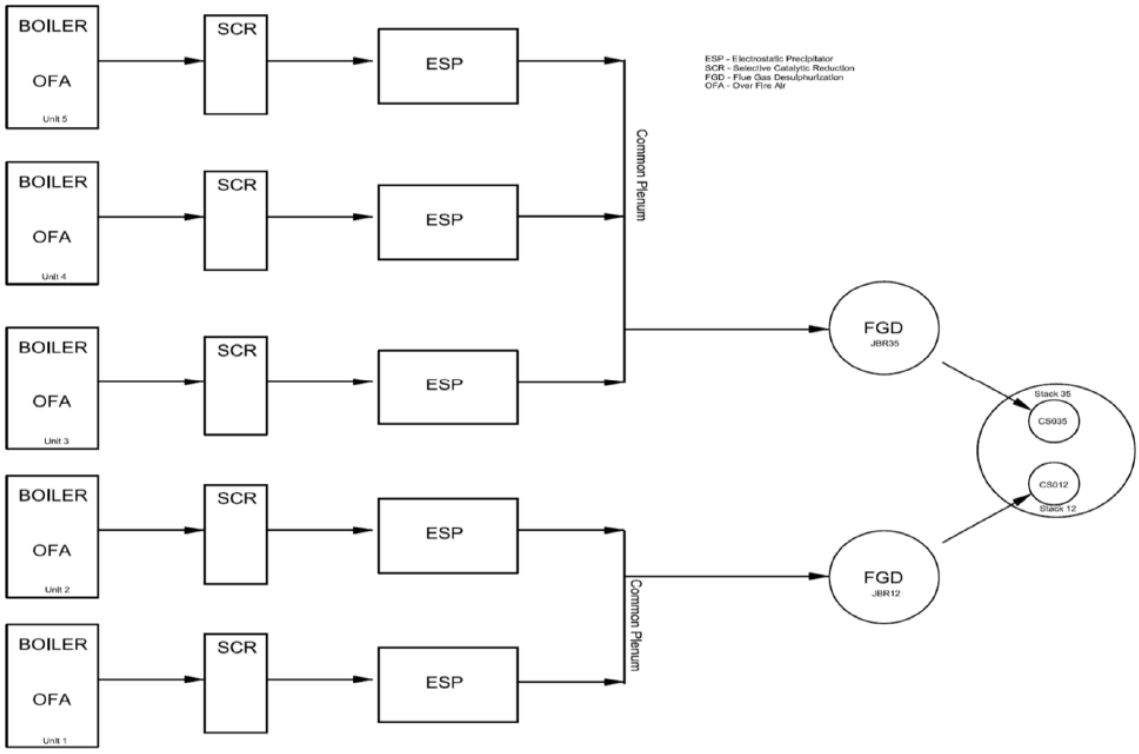


Figure 47. Kyger Creek air pollution control process



Source: LEI-DR-10.4.1_Attachment_1

Figure 48 demonstrates the profile of certain equipment and system installed at Kyger Creek and Clifty Creek facilities since the late 1970s to comply with environmental regulations.

Figure 48. Kyger Creek and Clifty Creek environmental compliance equipment

Project	Purpose	Installation Date	
Clifty Creek and Kyger Creek Plant – Electrostatic Precipitator (ESP) installation on all units	To meet Clean Air Act requirements for the removal of fly ash/particulate matter from the flue gas	1977-1980	
Clifty Creek and Kyger Creek Plants (all units) – boiler overfire air modifications	To meet Clean Air Act Amendment (Acid Rain Program) requirements for NOx emissions	1995-1999	
Clifty Creek and Kyger Creek Plants (10 of 11 units) – installed selective catalytic reduction equipment	To comply with ozone season only NOx requirements following additional US EPA NOx SIP call rulemaking	2002-2003	
Clifty Creek and Kyger Creek Installation of JBR Scrubbers	Compliance with CSAPR requirements for additional SO2 emission reductions, and gain co-benefit of Hg removal for compliance with the MATS rule	2011-2013	

Source: LEI-DR-16.4.1

7.3.3 OVEC's environmental compliance

7.3.3.1 OVEC's compliance with air, water, and solids regulations

During the audit period, with the adoption of EPA's CSAPR Update Rule, in both 2018 and 2019, OVEC managed its operations to comply with the more stringent NOx constraints effective during the 2017 ozone season.[139] In addition, OVEC can operate all units with SCR controls in all future ozone seasons in compliance with the constraints of the CSAPR Update Rule.[140]

OVEC has been using the Effluent Limitations Guidelines ("ELG") draft rules published in November 2019 as their basis for planning compliance activities of wastewater discharge from steam electric power generating plants, including FGD water discharge, boiler bottom ash, and fly ash. OVEC expected EPA's final revisions to the ELG rules in September 2019, however, EPA did not meet the timeline to finalize the ELG rules. EPA published draft ELG revisions in the Federal Register on November 22, 2019 instead, but the draft ELG revisions are expected to become the final rules by the end of 2020.[141] In light of the draft rules, "OVEC will have until no later than December 31, 2023, to modify how it manages bottom ash transport wastewater and no

[139] OVEC Annual Report 2018. https://www.ovec.com/FinancialStatements/AnnualReport-2018-Signed.pdf; OVEC Annual Report 2019. http://www.ovec.com/FinancialStatements/AnnualReport-2019-Signed.pdf

[140] OVEC Annual Report 2019. http://www.ovec.com/FinancialStatements/AnnualReport-2019-Signed.pdf

[141] LEI-DR-10.4.3

later than December 31, 2025, to modify how it manages FGD wastewater."[142] OVEC confirmed its engagement with a third-party engineering firm to develop a holistic compliance strategy based on the draft ELG rules, and other applicable federal and state regulations. Once the ELG rules become final, OVEC will also finalize their relevant compliance strategy.[143]

With regard to EPA Clean Water Act Section 316 (b) for cooling water intake structures, both Kyger Creek and Clifty Creek Power Stations are addressing compliance through an Electric Power Research Institute ("EPRI") collaboration project that several Ohio River plants are involved in. OVEC completed two years of entrainment sampling per the 316 (b) Rule requirement in 2015 and 2016, and submitted the final reports to Ohio EPA on November 1, 2018, and to Indiana Department of Environmental Management ("IDEM") on January 24, 2019.[144] OVEC will develop a comprehensive and detailed cost estimate for Clifty Creek Power Station, following consultation with IDEM and their site-specific determination of Best Available Technology ("BAT"), based on the 316 (b) Rule. This determination needs to be finalized before OVEC moves to the next steps of developing detailed costs and schedule.[145] IDEM will conduct their evaluation as part of the next National Pollution Discharge Elimination System ("NPDES") permit renewal for Clifty Creek, as the current permit is effective until May 1, 2022, and IDEM's evaluation to address Clifty Creek's future 316 (b) obligations is expected to happen in late 2021 or early 2022.[146]

With respect to compliance with the EPA CCR, OVEC noted in its most recent annual report that "*The Companies have completed all compliance obligations associated with the rule to date….Currently, approximately 60 percent of the coal ash and other residual products from our generating facilities are reused in the production of cement and wallboard, as soil amendments, as abrasives of road treatment materials, and for other beneficial uses*."[147]

7.3.3.2 OVEC's coal handling operation and housekeeping management

As discussed in 6.1.3.5, the coal supply for Clifty Creek Power Station is primarily from [redacted] and Kyger Creek Power Station's coal is from [redacted]. At both facilities' unloading stations (Clifty Creek has three, and Kyger Creek has two), coal is offloaded from a barge by a clam unloader and transferred by overhead conveyor to the coal yard, where the coal is stored and then transferred to the unit bunkers and distributed around. Both plants started with the same installation system, with a coal yard and storage area, but over time, Clifty Creek switched to burn a blended coal, which required additional equipment for

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[142] Ibid.

[143] Ibid.

[144] LEI-DR-10.4.4

[145] Ibid.

[146] Ibid.

[147] OVEC Annual Report 2019.

blending capability. Currently, Clifty Creek has a capacity of storing coal for [redacted], and Kyger Creek, for [redacted] far greater than the target of [redacted].[148]

OVEC has maintained an overall effective housekeeping practice. AEP painting specialists frequently inspect and make recommendations for the next areas to be recoated and third-party structural firms are hired to inspect the conveyors, stations, as well as unloading towers.[149] Both facilities also have 6S (Sort, Set in Order, Shine, Standardize, Sustain, and Safety) areas to create and maintain a clean, orderly, and safe work environment.

7.3.3.3 OVEC's byproducts from environmental compliance activities

During the FGD process, air is needed to support the reaction of the SO_2 in the gas with the limestone slurry, which creates spent slurry, as known as gypsum. The absorber removes the dewatered gypsum, which becomes a useful byproduct and source of revenue for OVEC.[150] OVEC has been selling nearly all of the gypsum produced at each plant into the wallboard market.[151] Kyger Creek has a long term contractual relationship with one wallboard manufacturer, and Clifty Creek is also nearing completion of a long term contract with another wallboard manufacturer.[152] Both plants are evaluating options for installing barge loading facilities on-site which could provide additional support for fly ash and boiler slag marketing.[153] The revenues from the sales of gypsum are used to offset the fuel and reagents costs incurred by OVEC.

Another byproduct is bottom ash, removed from the bottom of the boilers. After further cleaning, the ash can be used for grid blasting and becomes sellable. Clifty Creek has successfully marketed some of its fly ash, and OVEC expects a growing trend in that market. Kyger Creek is considering a marketing agreement for its dry fly ash in 2023 and beyond after the completion of the dry flash ash conversion project at the facility.[154] The revenue from the ash sales is expected to reduce total fuel and reagent costs.

7.3.3.4 AEP Ohio's compliance strategy

AEP and AEP Ohio keep track of all the changes associated with Clean Air Act, Clean Water Act, Resource Conservation and Recovery Act, Endangered Species Act, and Safe Drinking Water Act

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[148] Oral presentation from OVEC staff during the virtual plant site visit on August 6, 2020.

[149] LEI-DR-10.4.1

[150] Oral presentation from OVEC staff during the virtual plant site visit on August 6, 2020.

[151] OVEC Annual Report 2019. http://www.ovec.com/FinancialStatements/AnnualReport-2019-Signed.pdf

[152] OVEC Annual Report 2018. https://www.ovec.com/FinancialStatements/AnnualReport-2018-Signed.pdf

[153] Ibid.

[154] OVEC Annual Report 2019. http://www.ovec.com/FinancialStatements/AnnualReport-2019-Signed.pdf

to make sure they are in compliance.[155] The Company also takes active part in developing regulations "at the federal, state, and local levels to ensure the new requirements are achievable, based on sound science, consistent with statutory authority and balanced with other rulemakings."[156] AEP is supporting OVEC's environmental compliance activities at Clifty Creek and Kyger Creek Power Stations to meet the compliance goals and environmental stewardship.[157]

As to overall compliance strategy, the OVEC 2019 annual report noted that *"As a result of the installation and effective operation of the FGD and SCR systems at each plant, management did not need to purchase additional annual SO_2 allowances, annual NOx allowances, or ozone season allowances in 2019 to cover actual emissions. The Companies [OVEC and IKEC] also maintain a bank of allowances for all three programs as a hedge to cover future emissions in the event of any short-term operating events or other external factors. Depending on a variety of operational and economic factors, management may elect to consume a portion of these banked allowances and/or strategically purchase additional CSAPR annual and ozone season allowances in 2020 and beyond for compliance with the CSAPR and CSAPR Update rules."*[158]

7.3.4 Emissions allowances and trading

7.3.4.1 OVEC's designated staff

OVEC's ESH Director is the Designated Representative or Authorized Account Representative ("AAR"), who is in charge of overall emissions allowance inventory management and associated compliance activities, including but not limited to, the allowance bank management and surrender of allowances via EPA's Clean Air Markets Division ("CAMD") Business System website.[159] In addition, OVEC's ARR has an Alternate Authorized Account Representative ("AAAR"), who is the Environmental Services Manager based at OVEC's corporate office in Piketon, Ohio, and serves as a backup to fulfill purchasing, banking, inventory management, and annual allowance surrender responsibilities.

7.3.4.2 OVEC's purchasing strategy for emissions allowances

OVEC's strategy is to "operate in a manner to comply with applicable environmental requirements under both the state and federal implementation plans applicable to NOx and SO_2 emissions from the electric utility sector."[160] OVEC is required to manage emissions allowances under three regulatory programs: (1) CSAPR; (2) CSAPR Update Rule; and (3) Acid Rain Program. During the audit period, OVEC confirmed that they did not make any emissions

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[155] AEP Corporate Sustainability 2020 Report. http://www.aepsustainability.com/performance/report/

[156] Ibid.

[157] LEI-DR-3.4.1

[158] OVEC Annual Report 2019.

[159] LEI-DR-3.4.2

[160] Ibid.

allowances purchases in the secondary market and the only allowances received were those allowances allocated to each of the units by EPA under the three regulatory programs.[161]

OVEC did not purchase SO_2 allowances during the audit period, and does not expect to purchase SO_2 allowances in the near future, because of the high efficiency of JBR scrubbers coupled with the applicable state and federal environmental constraints associated with SO_2 emissions at both plants. Under the federal Acid Rain or CSAPR regulations, OVEC conducted annual allowance surrender obligations by utilizing the allowances allocated to the units under those respective compliance programs.[162]

As for NOx emissions control, OVEC's overall strategy is to "operate in a manner to limit or avoid the need to purchase annual or seasonal NOx allowances in the secondary market."[163] Currently, OVEC has very limited need to purchase additional allowances due to the stringent environmental compliance obligations and high efficiency of plants' pollution control equipment. Historically, OVEC's purchased NOx allowances in the spot market to either build up the plant accounts for hedging purposes, or to fulfill actual annual emissions surrender obligations during the past compliance periods. During the audit period, OVEC confirmed that neither seasonal nor annual NOx allowances were purchased.[164]

7.3.4.3 OVEC's purchasing process of emissions allowances

As mentioned above, OVEC did not make any allowance purchases during the audit period. But historically, OVEC's purchasing process for emissions allowances was mainly through the trading services of one of its Sponsors (usually AEP Ohio) to make sure the purchase were made based on fair market prices and reasonable brokerage fees at the time of the purchase.[165] For each allowance purchase, there was a purchase agreement between OVEC and the seller. OVEC conducted an internal legal review of the agreement terms that define the type, number, vintage, and total prices of allowances of each purchase. The ESH Director or ARR is responsible for managing the emissions allowances purchase to meet OVEC's needs.[166]

7.3.4.4 OVEC's banking strategy and management of emissions allowance inventories

OVEC's ARR and ARRR have the primary responsibility of fulfilling emission allowance management and associated compliance obligations, including banking and inventory

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[161] LEI-DR-3.4.4

[162] LEI-DR-3.4.2

[163] Ibid.

[164] Ibid.

[165] LEI-DR-3.4.3

[166] Ibid.

management.[167] The general strategy for banking and inventory management is that allowances surrenders are made on a last-in, first-out basis so as to minimize the costs incurred and billed to Sponsors.[168]

OVEC values historical allowance purchases on a weighted average basis and bills Sponsoring Companies based on the actual monthly emissions reported by Kyger Creek and Clifty Creek Power Plants.[169] "Allowances directly allocated to the plants by EPA are not assigned a cost and Sponsors are not billed when such allowances are surrendered."[170] AEP Ohio noted that since 2016, OVEC has not purchased any allowances of any kind and they have never purchased CSAPR Annual SO_2 allowances in the secondary market. Figure 49 below shows a summary of the 2019 beginning year (2019 vintage or earlier) allowance bank totals, the weighted average cost of allowances that still have a value from prior year purchases, the number of allowances surrendered in 2019, the 2019 balance, and additional 2020 vintage allowances EPA has allocated to the units for 2020.

[167] LEI-DR-3.4.6

[168] LEI-DR-3.4.6

[169] LE-DR-3.4.7

[170] Ibid.

Figure 49. OVEC emissions allowance account balance as of May 2020



Source: LEI-DR-3.4.7_Attachment_1

LEI notes that, at [redacted], the 2019 year-end inventory of ozone season NOx allowances for 2019 was worth[redacted]. This is the most expensive inventory of allowances—SO_2 and annual ozone inventory values are much lower, because the price of allowances are lower. As the EPA is providing about the same number of ozone season NOx allowances annually as the plants use annually, the ozone season inventory level shown for 2019 is probably higher than needed. But, though it may be overly conservative, LEI believes the inventory management for seasonal NOx allowances is reasonable. Management of other emissions inventories was reasonable and represent low costs to customers.

7.4 Recommendations

Based on the virtual plant site visit and data request responses from AEP Ohio, LEI concludes that OVEC's environmental equipment configuration is consistent with the industry standard, and therefore, OVEC is well positioned to comply with environmental rules and regulations at federal, state, and local levels. LEI found that OVEC has an effective management of emissions allowances given the dynamics in the market, regulatory changes, and efficiency of emission control system.

LEI makes the following recommendations:

- As EPA is still finalizing the ELG rules regarding wastewater discharge in the electric utility sector, OVEC should continue paying close attention to the regulatory updates and continue developing compliance strategy together with third-party engineering firms to make sure OVEC will meet the requirements in an efficient and timely manner.
- OVEC has already submitted its EPA 316 (b) report on closed cooling water systems and fish impingement mitigation systems to Ohio EPA and IDEM for Kyger Creek and Clifty Creek Power Plants. There is uncertainty about the capital expenses associated with the environmental compliance. OVEC should continue working closely with Ohio EPA and IDEM to determine the Best Available Technology at the lowest reasonable cost to meet the EPA 316 (b) rule.

8 Capital expenses

8.1 Scope and background

8.1.1 Scope

Capital expenses and all other "Demand Costs" (all non-fuel costs) incurred by OVEC are allocated and billed to AEP Ohio through the ICPA. These are billed to AEP Ohio customers in the Power Purchase Rider and are therefore within the scope of the audit.

This chapter addresses the following topics:

- Decision and budgeting procedure for capital expenses;
- Budgeted and actual capital projects over the audit period; and
- Prudency of project planning and management.

In coming to LEI's conclusions, LEI issued formal data requests and reviewed detailed project documents.

8.1.2 Background

LEI reviewed the capital project approval process as well as the budgeted and actual costs of capital projects during the audit period, to determine whether these projects were planned and managed prudently and billed to AEP Ohio properly.

8.2 Evaluative criteria

LEI focused its audit on answering the following questions:

1. Were capital projects planned using a prudent approval process?
2. Were capital projects well managed and completed within budget?
3. Were capital costs properly billed to AEP Ohio and its customers?

8.3 Findings and conclusions

8.3.1 The capital budget process at OVEC

At OVEC, any proposed capital project over $100,000 goes through a six-step process before receiving approval (see Figure 50).

Figure 50. The six-step capital budget process at OVEC



Source: LEI 2.3.2 Attachment 1

The six steps involve the following activities and teams:

1) At the **Capital Budget Kickoff**, capital justifications, requirements, and the planned timeline are reviewed;

2) At the **Capital Budget Submission** step, Project Leads (typically asset owners or process leads) submit capital projections request and justifications to the Budget Excellence Team;

3) The **Budget Excellence Team** consists of a group of individuals with multidisciplinary backgrounds and from various locations and departments. They will review the quality of the project's justifications and alternatives, asking questions and providing feedback;

4) The **Site Review Team,** consisting of the Plant Manager and plant Department Heads, will then review and give feedback regarding the projects and their justifications;

5) Next, the **Executive Management Team**, made up of the Chief Operation Officer ("COO"), Chief Financial Officer ("CFO"), Kyger Creek Plant Manager, Clifty Creek Plant Manager and Electrical Operations Director, will review the projects and then prioritize based on safety, environmental compliance, reliability risk and capital budget targets;

6) Finally, the **Board of Directors** ("BOD") will review and approve capital budgets at the annual BOD meeting. AEP Ohio is involved at this stage based on its representation on the Board of Directors.

LEI finds this capital project budget approval process provides a good foundation for capital project planning and implementing. However, the Company should specify more clearly the personnel in charge of each step. For example, at the Capital Budget Kickoff step, who is responsible for proposing a capital project and who reviews the proposal? In addition, the Company should establish standardized criteria (such as net present value, payback period, and/or comparison to alternatives), for evaluating and approving the proposed capital projects at each step.

8.3.2 No ceiling on capital spending

As LEI understands it, the review and approval of the Commission is not needed for OVEC to engage in capital spending projects. Under such circumstances, a cap or ceiling on annual expenditures would be prudent, to prevent over-investment. LEI recommends the Commission consider implementing such a cap. However, OVEC is not allowed to earn a return on capital projects.

8.3.3 Capital projects were generally completed within budget

LEI reviewed the budgeted and actual costs of OVEC's capital projects in 2018 and 2019, as well as the actual amount charged to AEP Ohio. LEI found that the capital projects were generally completed within or close to the budget, and that the total actual costs did not exceed the total budgeted costs in these two years (see Figure 51 and Figure 52 below).

Figure 51. Budgeted and actual costs of OVEC's capital projects, 2018



Source: DR LEI 2.3.3 Attachment 1

Figure 52. Budgeted and actual costs of OVEC's capital projects, 2019



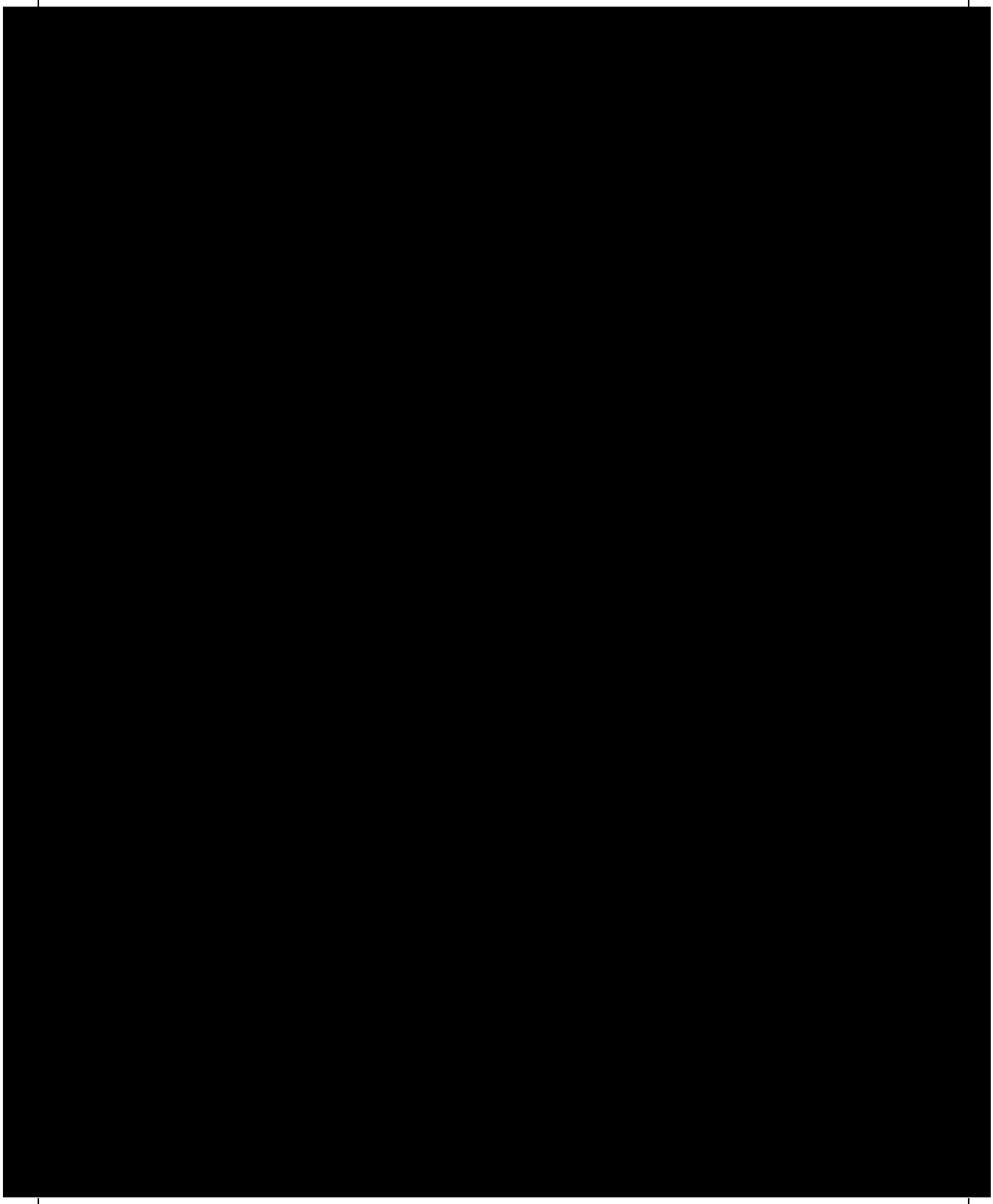
Source: DR LEI 2.3.3 Attachment 1

8.3.4 Capital projects are typically for safety and economic purposes with a payback period of around 4 years

LEI selected four projects that had relatively high costs or that had actual costs exceeding planned costs and reviewed the project data sheets to check the prudency of capital spending. These data sheets included detailed information on project description, cost and benefit analysis and alternatives considered (see Figure 53 below).

Upon reviewing the technical and financial details of the selected capital projects, LEI found that these projects were planned and completed on a prudent and reasonable basis. These projects were necessary for economic or safety purposes, went through cost-benefit analysis (with an average payback timeline of around 4 years), and were compared to alternatives in terms of practicality and cost.

Figure 53. Detailed summary of selected capital projects of OVEC





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Source: LEI 7.3.3 Confidential Attachment 1

8.4 Recommendations

LEI finds that in general, capital projects at OVEC were completed within budget and followed a fairly prudent evaluation process. The capital investment appears to have addressed critical safety issues or improved economics of the plants.

However, this does not imply that the level of capital spending is justified by the revenues earned in PJM. Most coal plants of similar size as Clifty Creek and Kyger Creek in PJM have either announced or are planning for deactivation due to economic viability issues and aging problems, and are therefore having limited capital investment. However, markets may change, and eventually support economic viability of coal plants which remain operational.

9 Power plant operations

9.1 Scope and background

9.1.1 Scope

OVEC's plant operation and maintenance activities, as well as resource planning practices affect the ultimate cost of power to OVEC consumers and are thus within the scope of this audit.

This chapter addresses the following topics:

- Organizational structure and qualifications of personnel;
- Power plant operation and maintenance; and
- Power plant performance tracking.

In coming to LEI's conclusions, LEI issued formal data requests, communicated with management, and conducted additional research.

9.1.2 Background

Clifty Creek includes six coal-fired generating units (total owned installed capacity 1,304 MW) and Kyger Creek includes five coal-fired generating units (total owned installed capacity 1,086 MW) (see Figure 54). The units are all relatively old (operating since 1955 or 1956) and small, with nameplate capacity of 217 MW each, while new coal steam turbines tend to be about 500 MW.

Figure 54. OVEC-owned generating units

Plant	Unit No.	Location	Technology	Initial Operation	Fuel	Nameplate Capacity	Max Avail Capacity
Clifty Creek	1	Jefferson County, IN	Steam Turbine	1955	Coal	217.3	200
Clifty Creek	2	Jefferson County, IN	Steam Turbine	1955	Coal	217.3	200
Clifty Creek	3	Jefferson County, IN	Steam Turbine	1955	Coal	217.3	200
Clifty Creek	4	Jefferson County, IN	Steam Turbine	1955	Coal	217.3	200
Clifty Creek	5	Jefferson County, IN	Steam Turbine	1955	Coal	217.3	200
Clifty Creek	6	Jefferson County, IN	Steam Turbine	1956	Coal	217.3	200
Kyger Creek	1	Gallia County, OH	Steam Turbine	1955	Coal	217.3	199
Kyger Creek	2	Gallia County, OH	Steam Turbine	1955	Coal	217.3	199
Kyger Creek	3	Gallia County, OH	Steam Turbine	1955	Coal	217.3	199
Kyger Creek	4	Gallia County, OH	Steam Turbine	1955	Coal	217.3	199
Kyger Creek	5	Gallia County, OH	Steam Turbine	1955	Coal	217.3	199

Source: Third-party data provider; OVEC Website https://www.ovec.com/Clifty.php

9.2 Evaluative criteria

LEI focused its audit of plant operations on answering the following questions:

1. Is staffing adequate in terms of numbers of employees and staff experience, training, oversight, performance incentives, and succession planning?
2. Do OVEC's plants perform at levels comparable to industry expectations?
3. How and on what criteria is plant performance benchmarked by OVEC? How does it compare to industry standards, best practices, or expectations?
4. How does OVEC plan and execute its maintenance activities?

9.3 Findings and conclusions

9.3.1 Review of recommendations for OVEC from the previous audit

9.3.1.1 Sliding pressure control

Vantage Energy Consulting made a recommendation in their PPA Audit Report, that OVEC should "consider implementing a sliding pressure control strategy to be utilized during low load periods." (Recommendation VI-R5, 2019 PPA Audit Report. pp 95). AEP Ohio agreed to address this with OVEC and the sponsoring parties to evaluate whether this recommendation would be appropriate; it is currently under evaluation.[171]

9.3.1.2 Performance Engineer

Vantage Energy Consulting in their PPA Audit Report noted that "there is no dedicated position that is responsible for individual unit performance and condition monitoring of selected critical components." They recommended that OVEC should "add a "Performance Engineer" position to the Clifty Creek and Kyger Creek organization" (Recommendation VI-R5, 2019 PPA Audit Report, pp 95). AEP Ohio noted in response to a data request from LEI that the recommendation was already being implemented through the engineering staff in the Technical department at Kyger Creek, and the Operation department at Clifty Creek, and did not believe that any additional action was necessary.[172]

9.3.1.3 JBR scrubber

Vantage Energy Consulting noted in the PPA Audit Report on page 89 that problems with the JBR-46 scrubber were a major availability detractor. They recommended that OVEC plants should "utilize the JBR team to develop a comprehensive predictive maintenance program for all the Jet Bubbling Reactor (JBR)" (Recommendation VI-R4, 2019 PPA Audit Report, pp 92). OVEC noted

[171] LEI-DR-13.5.1

[172] LEI-DR-13.5.3

that this process was already implemented and the Company believes that no additional action was required in response to the recommendation.[173]

9.3.2 Organization and staffing are reasonable at Kyger Creek and Clifty Creek

LEI examined the staffing of the OVEC and IKEC plant management teams. There are 228 staff working at Kyger Creek and 264 at Clifty Creek. The number of employees is comparable to other coal plants in the PJM.[174]

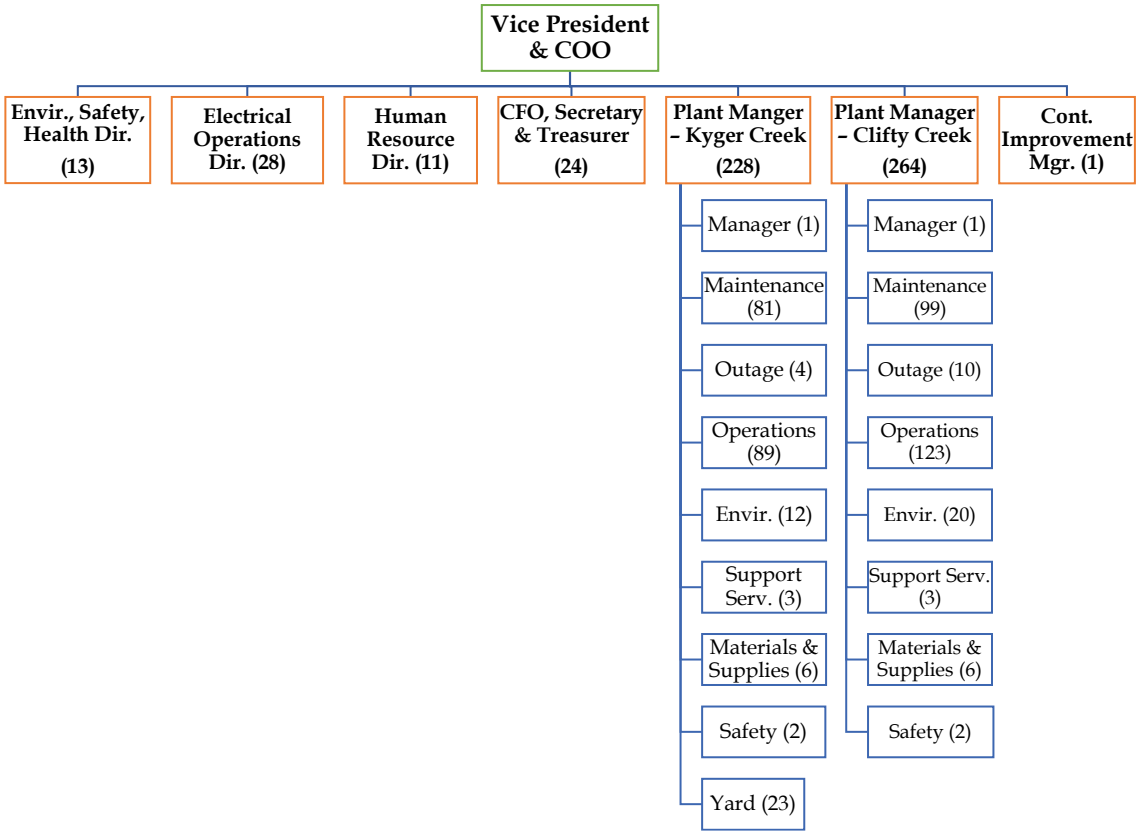
The total number of staff at both plants declined from 2019 to 2020. OVEC reports that this is the result of optimizing and challenging its staffing structure; it has been able to use attrition and before replacing positions, focus on absorbing or reallocated resources and determining core and non-core functions.[175] OVEC's goal is to continue to work and create a LEAN and cross-functional workforce. AEP Ohio reported that there were no major changes the management, organization, and staff responsibilities at the Clifty Creek and Kyger Creek plants.

[173] LEI-DR-13.5.2

[174] The average number of employees in the coal fired power plants in PJM is 206. Source: S&P Global Market Intelligence.

[175] LEI-DR-13.5.6

Figure 55. OVEC – IKEC plant management staffing

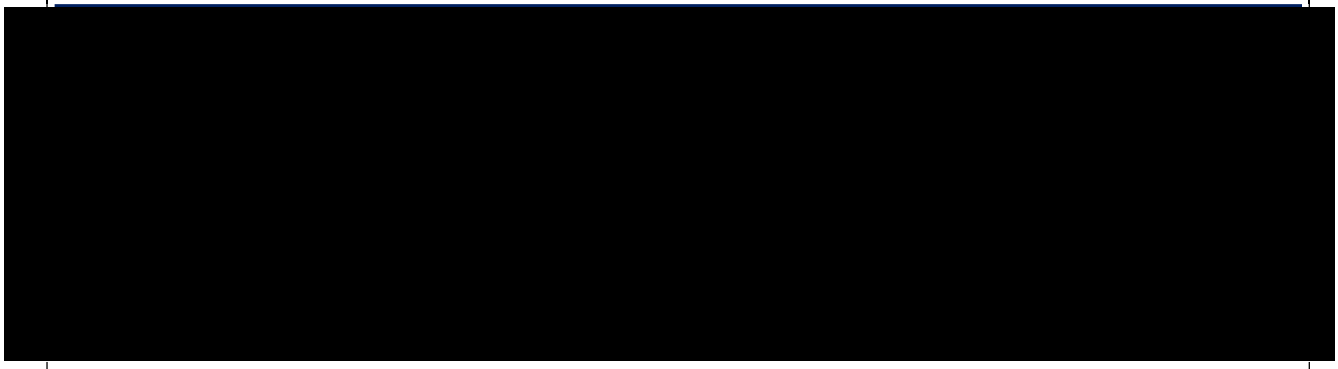


Source: LEI_1.5.1_Attachment_1

LEI examined the labor and non-labor cost for operating and maintaining ("O&M") the two plants. As shown in Figure 56, for the period of 2017-2019, the Clifty Creek and Kyger Creek plants spent an average of $38.4 million (or $29.43/kW-year) and $35.0 million per year (or $32.21/kW-year) on O&M, respectively. The total O&M cost on a dollar per kilowatt-year term is on the lower end of the industry average.[176] Around 25% to 30% of the total O&M cost at Clifty Creek and Kyger Creek is reported to have been spent on labor. This share is on the lower end of industry average base on LEI's empirical knowledge, but is not unreasonable given the considerable amount spending on materials that might be required in the event of planned or unplanned outages.

[176] EIA reports the Fixed O&M cost (including Routine Labor, Materials and Contract Services, and Administrative and General Expenses) for a plant of 650 MW nominal capacity, powered by Ultra Supercritical Coal, and without Carbon Capture facilities is $40.58/kW-year. Source: EIA. *Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies*. February 2020.

Figure 56. OVEC – Labor and non-labor O&M costs for Clifty Creek and Kyger Creek



Source: LEI_7.5.2

9.3.3 Plant maintenance strategies properly address routine activities and contingencies

OVEC plant maintenance includes the day to day maintenance activities driven by the maintenance planning process, "emergent" (emergency) work, unplanned outage work and outage preventative maintenance tasks.

Major outage projects (including but not limited to SCR catalyst replacement, air heater basket major replacement, major boiler tube replacements, ash hopper rebuilds, boiler feed pump rebuilds, pulverizer rebuilds, scrubber sparger tube replacements, and turbine inspections) require large crews for a specific duration to complete, and are therefore contracted. Craft labor is contracted for scaffolding, insulation, and vacuuming needs. Plant maintenance employees mostly conduct routine maintenance, testing, and small calibration and repairs (such as damper repairs, precipitator routine maintenance, miscellaneous small valve repairs and replacements, air preheater seals and basket replacement, instrument and control MATS calibrations and testing, electrical breaker cleaning and relay calibrations).

During planned outages, plant maintenance primarily focuses on emergency, referred to as "emergent" work, with some personnel assigned to planned outage work. OVEC-IKEC moved plant maintenance work to contract labor for projects such as pulverizer rebuilds (2019 Kyger Creek and Clifty Creek) and turbine rebuilds (2019 Kyger Creek, and prior to 2018, Clifty Creek).[177]

9.3.4 Planned outage process is well designed

Outages at OVEC's plants are planned and executed by the Outage Management Team, which involves the following key members:[178]

[177] 1st Set of Responses to PUCO 18-1759 (LEI-DR-1.5.3)

[178] LEI 1.5.2_Attachment_1

- **Outage Manager:** assigned by the Plant Manager, or delegate. This individual is responsible for the maintenance of the opportunity outage pool lists (when unanticipated changes on the power system allow work to take place), planning, scheduling, and day-to-day management of the outage;
- **Outage Planner:** responsible for planning outage work orders to support pre-outage, outage execution and closure. This individual serves as the single point contact responsible for communication of outage work order planning;
- **Outage Scheduler:** responsible for development, analysis, reporting, integration, maintenance and historical retention of outage schedules to support pre-outage, outage execution and closure;
- **Clearance Coordinator:** assists members of the Outage Management Team;
- **System Lead/Engineer:** responsible for the planning, execution and closeout of specific planned outage systems or projects;
- **Maintenance Manager:** supports the outage by providing necessary resources and holding those assigned accountable to safely execute planned work;
- **Maintenance Production Superintendent:** coordinates resources to support the execution of the scheduled outages;
- **Maintenance Supervisor:** responsible for execution and closeout for labor and maintenance activities;
- **Safety Coordinator:** the point of contact for safety review, execution, and improvement at the plant;
- **Environmental Coordinator:** the point of contact for environmental review, execution, and improvement at the plant;
- **Outage Coordinator:** responsible for coordinating assigned outage activities such as contracted cleaning services, or large scale projects requiring oversight.

OVEC has a standard planned outage process in place that provides a structure for outage planning, implementation, and continuous improvement. The process monitors four key steps, namely: Preplanning, Planning, Execution, and Close-out (see Figure 57).[179]

The **Preplanning process** provides the plan for all long-term strategic planning, budgeting, and material purchases. Five-year forecasts for O&M and capital budgets are developed, and the high-level scope for each outage is established. Long lead material purchases are identified, planned, budgeted, and ordered. On an annual basis the following year's budget is tentatively approved by top level management.

[179] LEI_1.5.2_Attachment_1 (OVEC/IKEC Planned Outage Handbook)

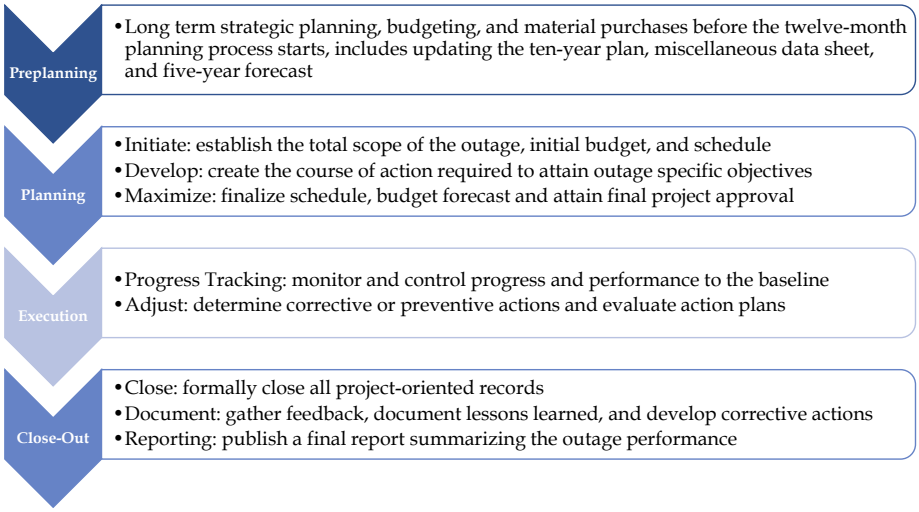
The **Planning** process develops the annual project plan and documents that will be used to carry out the outage. The Planning step is made up of three phases: *Initiate, Develop, and Maximize*. These phases encompass a twelve-month (48-week) timeline, and there is overlap among them.

- The *Initiate* phase consists of processes performed to establish the total scope of the outage and it is conducted during the first six months of the twelve-month planning timeline. The outage scope will include the required maintenance for continued safe and environmentally responsible operation of the unit. Along with the scope, an initial budget forecast and a level 1 schedule (i.e. a high-level overview) is developed which depicts the outage duration in the form of major milestones needed for successful completion.

- The *Develop* phase consists of creating the course of action required to attain specific outage objectives (including cost, schedule, and scope) through the planning of each job. This takes two months of the twelve-month planning timeline. The outage scope is further developed to meet unit performance expectations within budget constraints.

- The *Maximize* phase finalizes the course of action required to attain specific outage objectives. This phase includes publishing the level 3 schedule[180], finalizing the forecast and attaining final project approval through a formal readiness review with Plant Senior Management. This phase starts three months into the planning phase, while the initiate phase is still under way. The Maximize phase concludes with a Readiness Review, which presents to Senior Management the safety plans, work scope, budget, schedule, and project risks.

Figure 57. OVEC's outage planning process



Source: LEI_1.5.2_Attachment_1

[180] A Level 3 schedule is a detailed with all work logic tied, and the critical path well outlined.

The **Execution** step consists of the processes performed to track, review, forecast and regulate the progress and performance of the outage. Execution is made up of two phases: *Progress Tracking* and *Make Adjustments*. The *Track* phase acts as the embedded test measuring progress versus baseline expectations, while the *Adjust* phase represents the countermeasures put in place to rectify any change or deviations from the plan.

- The *Progress Tracking* phase includes monitoring and controlling progress and performance to the baseline. Progress and performance are tracked through the Execution Key Performance Indicator's ("KPIs"): Safety, Budget, Schedule, Scope, and Quality.
- The *Adjust* phase involves determining corrective or preventive action and following up on action plans to determine if the actions taken resolved the performance issues. When changes occur, the System Lead reports effects of that change against the outage KPIs to Outage Manager.

The **Close-Out** process consists of the processes performed to finalize all activities and complete the outage. The Close-Out process is made up of three phases: *Close, Document, and Reporting*. The benefits of this phase are documented lessons learned, archived project documentation, contract closure and process updates. This process encompasses a three-month timeline after the unit has been returned to operation.

- The *Close* phase includes involves the disposition of all unused material, rentals, and finalizing all contracts and work orders.

- The *Document* phase involves those processes necessary to gather feedback, document lessons learned, and develop corrective actions for any issues encountered during all phases of the outage process.

- The *Reporting* phase results in a final report. An outage summary is completed to evaluate project performance against the objectives of safety, scope, schedule, cost, and quality. Recommended future work will be included as well. The final report is completed by the Outage Manager following the OVEC/IKEC Outage Reporting procedure.

Upon reviewing the Planned Outage Handbook LEI finds OVEC's outage planning to be thorough and well-documented. Activities involved in each step are laid out in an organized way and responsibilities regarding are clearly assigned to specific personnel.

9.3.5 Plant maintenance costs during outages are budgeted reasonably at Clifty Creek, but budgeting need to be improved at Kyger Creek

Actual outage maintenance costs are charged to AEP's customers through the PPA Rider. Therefore, it is important to evaluate the reasonableness and prudency of OVEC's outage maintenance costs and to ensure that such costs are billed properly to AEP Ohio.

LEI compared the generation assets' non-fuel O&M budget to actual maintenance costs for the audit period and 2017 (see Figure 58).

LEI observed that the actual outage maintenance costs were about 30% lower than the budgeted costs throughout the 2017-2019 period. In 2018, the outage activities of OVEC-IKEC's generating fleet represented a cost of approximately $34.9 million, compared to budgeted costs of $45.3 million, which is 23% lower than forecasted (but was 17% higher than 2017). In 2019, the cost was about $28.8 million, which is 33% lower than the budgeted costs of $42.8 million and 18% lower than 2018.

For Clifty Creek, the discrepancies between budgeted costs and actual costs for outage maintenance have narrowed from 37% in 2017 to 33% in 2018, and to 23% in 2019. The was primarily due to the decreasing differences between actual and budgeted maintenance costs for planned outages (as opposed to unplanned outages). However, the actual outage maintenance costs have been increasing since 2017 (see Figure 58).

As for Kyger Creek, the differences between budgeted costs and actual costs for outage maintenance dropped from 30% in 2017 to 9% in 2018, and then increased to 44% in 2019. The actual costs for planned outages have been consistently lower than budgeted costs by about 40%. In contrary, the actual costs for unplanned outages in 2017 and 2018 were significantly higher than budget, and actual costs for unplanned outages in 2019 was much lower than budgeted in 2019.

LEI suggests that OVEC revisit and refine the maintenance budget processes, especially for Kyger Creek. Moreover, establishing a feedback loop (reporting dollars spent, time needed for the project, etc., comparing actuals with budget) will help improve the budgeting process.

Figure 58. Maintenance costs for OVEC plants, budget vs actual for planned and unplanned outages, 2017-2019



Source: LEI_2.5.2_Attachment_3

Note: Costs do not include routine maintenance or maintenance that does not require a unit outage.

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Figure 59. Maintenance costs for Clifty Creek, budget vs actual for planned and unplanned outages, 2017-2019



Figure 60. Maintenance costs for Kyger Creek, budget vs actual for planned and unplanned outages, 2017-2019



9.3.6 Plant performance

OVEC-IKEC utilizes key indictors or metrics as part of their Open Book Leadership ("OBL") initiative where key metrics are reviewed on a weekly or monthly basis with employees. OBL is a management philosophy that the Company has utilized since 2015 to empower employees by providing them the information, education, and communication necessary to understand how the Company performs and how they can impact that performance. The Company utilizes an internal benchmarking process to set performance goals for improvement every year. Key plant metrics for OVEC-IKEC for 2017 through 2019 include safety, environmental compliance, budget adherence, and unit performance metrics such as equivalent forced outage rate, heat rate, capacity factor, equivalent unplanned outage factor, and equivalent availability factor. [181]

For purposes of this audit, LEI focused on the following key performance indicators:

- Heat Rate ("HR"), which measures the plant's efficiency in converting thermal energy from fuel into electrical energy;
- Capacity Factor ("CF"), which measures the ratio of actual energy output to the maximum possible energy output over a given period of time;
- Equivalent Forced Outage Rate ("EFOR"), which is the proportion of a period where a unit is not available due to forced outages and forced deratings; and
- Equivalent Availability Factor ("EAF"), which is the proportion of a period where a unit is available without any outages or equipment deratings.

9.3.6.1 Heat rate data implies OVEC plants have generally maintained or improved their efficiency in 2019

Heat rates, typically expressed in Btu/kWh, measure the efficiency with which a unit converts the energy from fuel into electricity. The lower the heat rate, the more efficient is the unit at generating electricity from a given amount of fuel. As a result, plants with lower heat rates will burn less fuel, and so cost less to generate a given amount of electricity (all else being equal).

Several factors can influence a unit's heat rate, such as original design, operating parameters, age, or unit load. Maintenance is important to ensure that the heat rate will not increase significantly as the unit ages.

LEI examined three years of annual heat rates, including the latest audit period (2018-2019) and one previous year (see Figure 61). In general, OVEC units have maintained their heat rates in recent years. Clift Creek Unit 4 and 6, as well as Kyger Creek Unit 3 have seen a significant improvement in heat rate in the current audit period compared to 2017, decreasing by more than

[181] 1st Set of Responses to PUCO 18-1759 (LEI-DR-1.5.5)

5%. The heat rate for Kyger Creek 1 worsened by 5.5% from 2017 to 2018, and almost remained at the same level in 2019.

Comparing to other coal units of similar size in PJM, OVEC's units have been operating with higher efficiency. Many of these other PJM coal plants are running at very low capacity factors (discussed in more detail in Section 9.3.6.2). A low CF can result in higher heat rates, if the plants cannot run at optimal levels of output. Some such plants and have either announced or are planning for deactivation due to economic viability issues and aging problems.[182]

Figure 61. Generation asset heat rates (Btu/kWh)



9.3.6.2 OVEC plants have been running at relatively high capacity factors

The CF is calculated as the ratio of the actual energy generation over a given period of time to the maximum possible generation over that period. Typically, plants with lower operating costs (based on cheaper fuel and/or lower heat rates) will have higher capacity factors, because they are dispatched more often, although other causes such as maintenance or planned outages can affect a plant's generation output.

The following figures illustrate the trend in Net CF ("NCF")[183], EAF, and EFOR for five units at Clifty Creek and five units at Kyger Creek for 2017, 2018, and 2019.

[182] For example, W H Sammis ST 1-4 retired in May 2020, Dickerson ST 1-3 are currently under reliability review by PJM for deactivation, Birchwood Power Facility ST 1 is scheduled to retire before 2021.

[183] Net generation is the gross unit generation less the parasitic (auxiliary) load used by the unit to generate the gross output. (6th Set of Responses to the PUCO 18-1759-EL-RDR, LEI DR 6.5.1)

Figure 62. Capacity factors of OVEC units



Source: LEI_1.5.5_Confidential_Attachment_2

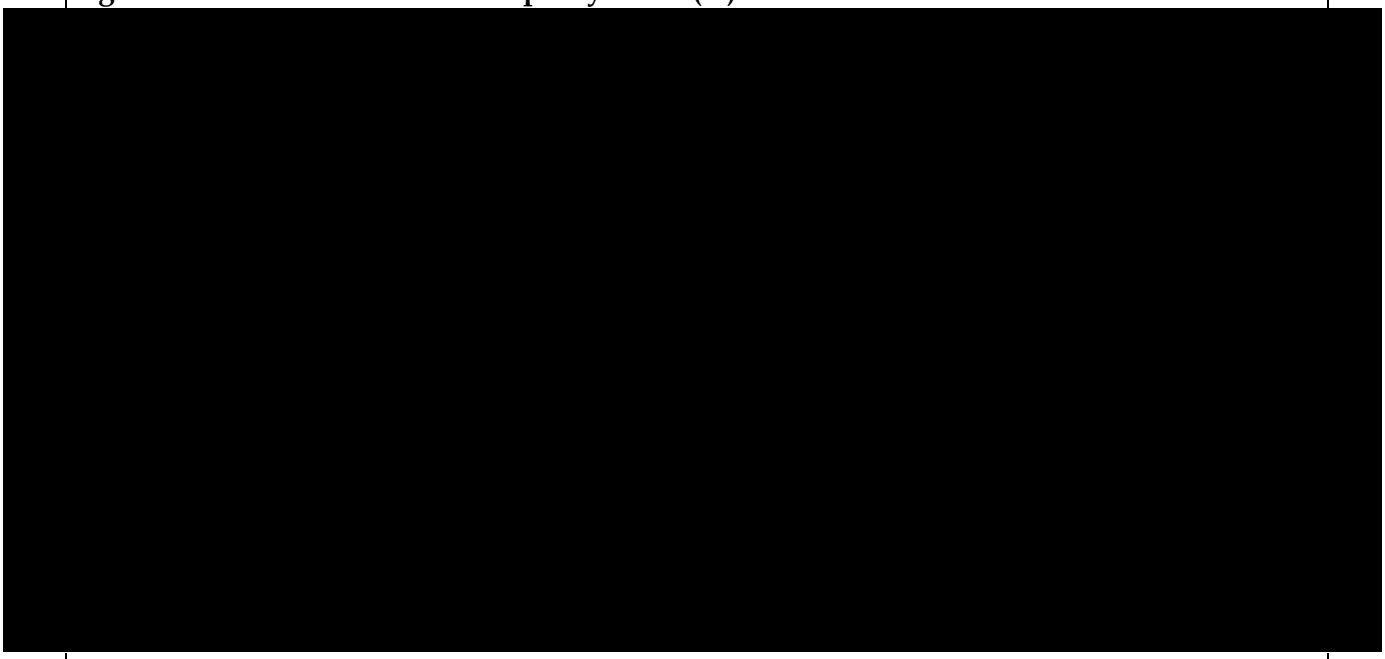
LEI observed that when there are no outages, units at Clifty Creek have maintained generally high efficiency over the 2017-2019 audit periods, with a Net CF in the [redacted] range.

Units 1-5 at Clifty Creek appear to have been running at a higher or similar CF in 2019 than in 2018 and 2017, but Unit 6's CF and EAF in 2019 are lower than the previous 2 years. The CF and EAF of Clifty Creek 6 is more volatile than the other units, as that unit is dispatched based on economics during the NOx season.

Kyger Creek operated at a relatively high CF ([redacted] when not on outage during 2017-2019.

Comparing to other coal plants of similar sizes in the US, all units at the Clifty Creek and Kyger Creek plants, except Clifty Creek 6, have been operating at a higher-than-average CF. All units have had CFs higher than the average of other PJM coal plants of similar sizes. Many of these PJM plants must compete in the PJM market based on variable cost.

Figure 63. Generation assets net capacity factor (%)



Source: LEI_1.5.5_Confidential_Attachment_2; NERC 2014-2018 average generating unit statistics (for coal plants of with nameplate capacity of 200-299 MW)
Note: 1. NERC has not published 2019 statistics, so LEI used the average of 2014-2018 values as a proxy
2. Numbers highlighted in yellow indicate NCFs that are lower than the industry average by more than 10% - 20%
3. Numbers highlighted in red indicate NCFs that are lower than the industry average by more than 20%

9.3.6.3 EAF and EFOR data suggests OVEC plants are fairly reliable, though inspection and maintenance actions are needed at Clifty Creek 6

In general, units at Clifty Creek and Kyger Creek were operating at a relatively high EAF (higher th and remained at a low EFOR (Clifty Creek 1 had an EFOR over 60% in October 2018, Unit 3 had EFORs in November 2017 and October 2018, Unit 5 had an EFOR of in May 2017, Unit 6 had EFORs at in July and August 2017, and July 2019. Kyger Creek had a lower EFOR than Clifty Creek during this period, except that Kyger Creek Unit 5 had a in March 2018 and Unit had a November 2017.

Figure 64. Equivalent availability factors of OVEC units



Source: LEI_1.5.5_Confidential_Attachment_2

Figure 65. Equivalent forced outage rates of OVEC units



Source: LEI_1.5.5_Confidential_Attachment_2

LEI finds that the reliability performance of Clifty Creek and Kyger Creek plants improved in 2018 and 2019, compared with 2017, with lower forced outage rates. Clifty Creek 6 appears to be an outlier (poor performer) in 2017 and 2019, with EFOR higher than industry average, and higher than its 2018 EFOR, as well as higher than other units at the Clifty Creek plant.

In terms of EAF, units at both plants performed better in 2019 than the previous two years. Clifty Creek 6 had significantly lower-than-industry-average EAFs in 2017 and 2019.

LEI examined the reasons for forced outages at [redacted]

OVEC has undertaken several repairs and replacement of [redacted] LEI suggests that OVEC take action to inspect and fix the technical problems [redacted] minimize forced outages and the related economic losses.

Figure 66. Generation assets equivalent forced outage rate (%)

[redacted]

[184] LEI_2.5.1_Attachment_1

Figure 67. Generation assets equivalent availability factor (%)



9.4 Recommendations

Based on the observations discussed in this section, LEI makes the following recommendations for improving the operations of the two OVEC plants:

- OVEC should closely monitor performance of
- OVEC should revisit and refine the maintenance budget processes, especially for Kyger Creek. Establishing a feedback loop will help improve the budgeting process.

10 Appendix of Acronyms

AAAR	Alternate Authorized Account Representative
AAR	Authorized Account Representative
ACP	Alternative Compliance Payments
AEC	Atomic Energy Commission
AEP Ohio	Ohio Power Company
AEPSC	American Electric Power Service Corporation
A/S	Ancillary Service
BAT	Best Available Technology
BOD	Board of Directors
BP	Base Product
BRA	Base Residual Auctions
BTU	British Thermal Unit
CAA	1970 Clean Air Act
CAIR	Clean Air Interstate Rule
CAMD	Clean Air Markets Division
CAMR	Clean Air Mercury Rule
CCGT	Combined Cycle Gas Turbine
CEMS	Continuous Emissions Monitoring System
CF	Capacity Factor
CFO	Chief Financial Officer
COO	Chief Operation Officer
CO_2	Carbon Dioxide
CP	Capacity Performance
CSAPR	Cross-State Air Pollution Rules
DA	Day Ahead
DOE	Department of Energy
DR	Data Request
EAF	Equivalent Availability Factor
EFOR	Equivalent Forced Outage Rate
EIA	Energy Information Administration

ELG	Effluent Limitations Guidelines
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ESH	Environmental, Safety, and Health Department
ESP	Electricity Security Plan
FERC	Federal Energy Regulatory Commission
FES	FirstEnergy Solutions
FGD	Flue Gas Desulfurization
FP	Fuel Procurement
FRR	Fixed Resource Requirement
HB 6	House Bill 6
HR	Heat Rate
ICPA	Inter-Company Power Agreement
IDEM	Indiana Department of Environmental Management
IKEC	Indiana-Kentucky Electric Corporation
IRP	Integrated Resource Plan
JBR	Jet Bubbling Reactor
KPI	Key Performance Indicator
kWh	Kilowatt Hour
LCOE	Levelized Cost of Energy
LDA	Locational Delivery Area
LEI	London Economics International
LSE	Load Serving Entity
MATS	Mercury and Air Toxics Standards
MISO	Midcontinent Independent System Operator
MOPR	Minimum Offer Price Rule
MW	Megawatt
NCF	Net Capacity Factor
NERC	North American Electric Reliability Corporation
NOx	Nitrous Oxides
NPDES	National Pollution Discharge Elimination System
OBL	Open Book Leadership

O&M	Operation and Maintenance
OVEC	Ohio Valley Electric Corporation
PPA	Power Purchase Agreement
PPR	Power Participation Rate
PUCO	Public Utilities Commission of Ohio
REC	Renewable Energy Credit
RFP	Request for Proposal
RGGI	Regional Greenhouse Gas Initiative
RPM	Reliability Pricing Model
RPS	Renewable Portfolio Standard
RSR	Retail Stability Rider
RT	Real Time
RTO	Regional Transmission Owner
SCR	Selective Catalytic Recovery
SGEE	Steam Generation Equipment Engineering
SO2	Sulfur Dioxide
SREC	Solar Renewable Energy Credits
SVP	Senior Vice President
UCS	Union of Concerned Scientists
US	United States
VP	Vice President
WWTP	Wastewater Treatment Plant

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