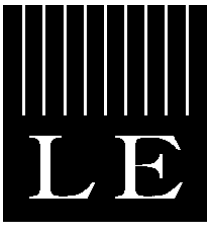
AUDIT OF THE LEGACY GENERATION RESOURCE RIDER OF AES OHIO
FINAL REPORT

PUBLIC VERSION

Prepared for

Public Utilities Commission of Ohio

By



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Audit of the Legacy Generation Resource Rider of AES Ohio: Final report

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

December 15, 2021

London Economics International LLC ("LEI") was selected by the Public Utilities Commission of Ohio to conduct an independent audit of the Legacy Generation Resource Rider ("LGR") Rider of AES Ohio ("AES"). The audit period covers January 1, 2020 through December 31, 2020. The Commission engaged LEI through RFP No. RA21-PPA-1.

LEI's scope of work encompassed the following tasks:

- ***providing industry context;***
- ***reconciling OVEC bills and AES Ohio riders;***
- ***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 AES, 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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Important Disclaimer Notice

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1 Executive summary and recommendations

1.1 Objective and purpose

AES Ohio is an investor-owned electric utility regulated by the Public Utilities Commission of Ohio ("PUCO" or "the Commission"). AES Ohio is a Sponsoring Company of the Ohio Valley Electric Corporation ("OVEC"), meaning that AES 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.

In 2019, House Bill 6 ("HB 6") defined a legacy generation resource ("LGR") in a way which encompassed the OVEC plants (RC 4928.01(A)(41)). New riders were needed to replace existing OVEC riders starting on January 1, 2020.[2] AES's Legacy Generation Resource Rider ("LGR") became effective January 1, 2020.

The Commission engaged LEI to audit the LGR Rider for the period January 1 through December 31, 2020. The purpose of the audit is to establish the prudency of all the costs and sales flowing through the LGR Rider, and to investigate whether AES Ohio's actions were in the best interest of its retail ratepayers.[3]

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 AES Ohio LGR Rider reconciliation:** Examination of whether charges on the OVEC bill are accurately reflected in AES Ohio's accounts, and also in the LGR Rider;
3. **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;

[1] LEI-DR-06-001 Attachment. *Amended and Re-Stated Inter-Company Power Agreement.*

[2] Dickinson Wright PLLC. *Ohio Enacts Sweeping Energy Legislation: HB 6 Bails Out Nuclear, Coal; Rolls Back Renewables and Energy Efficiency*. September 2019. <https://www.dickinson-wright.com/news-alerts/ohio-enacts-sweeping-energy-legislation>

[3] Public Utilities Commission of Ohio. Request for Proposal No. RA21-PPA-1. Issues January 29, 2020. P.2.

4. **Fuel and variable costs:** An assessment of OVEC's fuel 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;
5. **Capital expense:** Examination of the prudency of OVEC's process for allocating capital and conducting capital projects, and an assessment of whether the fixed costs incurred by OVEC are properly allocated to AES Ohio, including depreciation, debt service, and plant maintenance expenses;
6. **Environmental compliance:** A review of 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
7. **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 a virtual site visit.

1.2 LEI's audit approach

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

- LEI issued formal data requests over the time period August 2021 through November 2021, and kept a database and numbering system which logged requests issued and responses received;
- LEI held conference calls and numerous email exchanges; and
- 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, and coal handling operations.

Another key component of LEI's audit was to compare and benchmark 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 LGR 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 AES 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.

LEI's analysis shows that at this time 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:

Components of fixed cost: The components of fixed costs were billed properly. 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 (similar to a dividend). OVEC's capital expenditures are not part of a rate base for which they are allowed a regulated rate of return, but Component D is itself a return to the owners of OVEC. ORC 4928.01(A)(42) requires that "*Prudently incurred costs …must exclude any return on investment in common equity…*"[4] Component D seems to be a such a return. Though it is not a large share of the overall OVEC bill to ratepayers, the annual [redacted] million per year for Component D amounted to nearly all OVEC's [redacted] million of net income in 2020.[5]

Disposition of energy and capacity: OVEC energy and capacity are sold into the PJM markets. OVEC typically self-schedules its units in the PJM day-ahead market (in other words, OVEC informs PJM that a unit's availability status is "must-run"). The alternative to must-run availability status for a unit which is not on outage is to offer the unit so that it may be committed by PJM (in other words, OVEC would inform PJM that a unit's availability status is "economic").[6] Must-run units are committed by the market participant and then dispatched by PJM without

[4] PUCO. RFP No. RA21-PPA-1. Issued January 29, 2020. P.3.

[5] OVEC. *Annual Report 2020*. <https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf>

[6] PJM Manual 11. P. 30. <https://www.pjm.com/-/media/documents/manuals/m11.ashx>.

regard to whether the hourly energy price is high enough to cover the unit's fuel and variable costs. LEI's analysis (based on monthly average PJM prices) shows that some of the time during the audit period, the PJM energy price did not cover fuel and variable costs. LEI believes the temporary permission given by the OVEC Operating Committee (of which AES Ohio is a member) to allow the OVEC plants to be committed either as must-run or based on economic commitment (discussed in Section 5) was prudent. That option was in place temporarily in 2020; LEI recommends that AES Ohio and the other members of the Operating Committee allow this flexibility on an ongoing basis. Ideally, the units would be committed based on economics all or most of the time, but in the case of coal plants this can cause difficulties in managing staffing and fuel deliveries, and repeated start-up of coal plants can damage equipment. In terms of disposition of capacity, LEI recommends that AES Ohio consider developing price and volume offer pairs based on analysis of bonus payments and penalties at various MW offer levels.

Fuel and variable cost expenses: Coal inventories were much higher than target levels in 2020. LEI recommends that AES Ohio, through its role on the Operating Committee, encourage ongoing review and improvement to OVEC's coal burn forecasting methods, and coal procurement practices.

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.

Environmental compliance activities: Based on LEI's virtual site visit, 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 reliably in 2020, with forced outage rates generally better than PJM averages; and availability factors slightly higher than PJM averages for some units, and slightly lower for other units. However, heat rates were higher (i.e., efficiency was lower) than in 2019 owing to weaker demand and low energy prices in 2020, which resulted in plant dispatch at levels below optimal operating levels.

In the previous audit of AES Ohio's DPL Reconciliation Rider ("RR") in Docket No. 18-1379-EL-RDR,[7] the auditor made several recommendations. Figure 1 shows the current status of the recommendations.

[7] Vantage Consulting. *Independent Audit of the Reconciliation Rider of Dayton Power and Light, Final Report*. Response to RFP No. RA20-PPA-2. October 1, 2020.

Figure 1. Auditor recommendations from AES Ohio RR audit for 2019

Topic	Auditor recommendation	Status or outcome
Disposition of energy and capacity	Prepare report for PUCO covering potential ancillary services OVEC plants could provide	under way
Capital expenditures	Examine small projects to determine if they are capital in nature	unknown
OVEC bill and rider reconciliation	Formally document the procedures for cost recovery for OVEC capital costs and expenses	unknown
Environmental compliance	OVEC operating Committee should continue to monitor projected implementation of regulations, and the impact on operations	under way

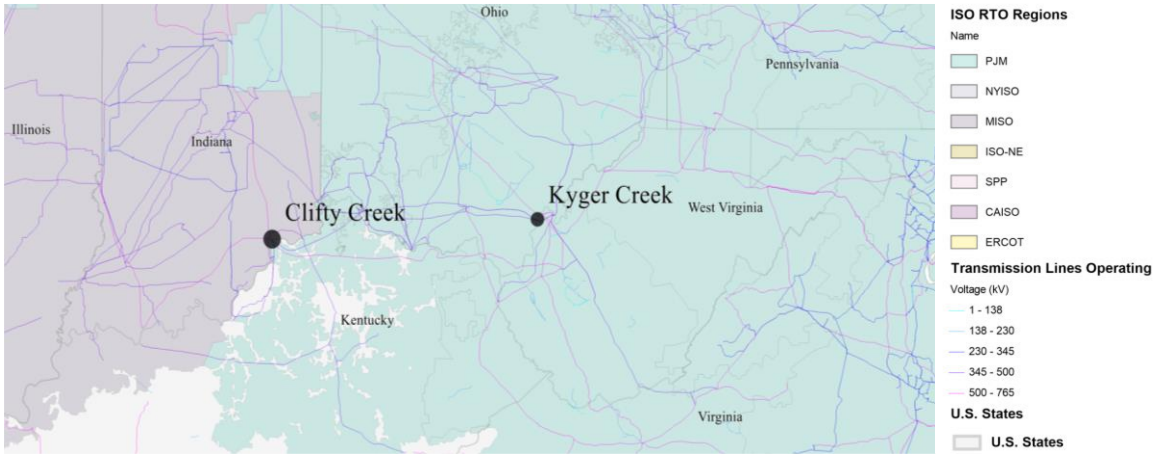
2 Introduction

2.1 Introduction to Ohio Valley Electric Corporation

Ohio Valley Electric Corporation ("OVEC") and its wholly owned subsidiary, Indiana-Kentucky Electric Corporation ("IKEC"), were established on October 1, 1952. OVEC and IKEC were established by investor-owned utilities ("IOUs") 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."[8] As of 2020, OVEC is owned by various IOUs or utility holding companies and two affiliates of generation and transmission rural electric cooperatives. These entities or their affiliates comprise the Sponsoring Companies. The Sponsoring Companies purchase power from OVEC according to the terms of the Inter-Company Power Agreement ("ICPA"), which is in place until June 30, 2040.[9]

OVEC owns two coal-fired power plants. OVEC's Kyger Creek Power Plant at Cheshire, Ohio, and IKEC's Clifty Creek Power Plant at Madison, Indiana, have nameplate generating capacity of 1,086.3 MW and 1,303.56 MW respectively.[10] The two generating stations began operating in 1955 and are connected by a network of 705 circuit miles of 345 kV transmission lines that also interconnect with the major power transmission network of several of the utilities in the area (see Figure 2).[11]

Figure 2. OVEC generating stations, 2021



Source: S&P Global Market Intelligence.

[8] "Ohio Valley Electric Corporation." *OVEC*. Web. October 29, 2021. < https://www.ovec.com/OVECHistory.pdf>

[9] OVEC. *Annual Report 2020*. p. 8. <https://www.ovec.com/FinancialStatements/2020-ConsolidatingFinancials.pdf>

[10] "OVEC-IKEC." *OVEC*. Web. October 29, 2021. <http://www.ovec.com/ContinueReading.php>

[11] Ibid.

Between 2019 and 2020, OVEC's net generation declined by 19.69% from 11,238,298 MWh to 9,025,018 MWh.[12] During the same period, the total power cost to Sponsors declined at 5.54% from 640.80 million to $605.27 million.[13] [14] As a result, the average power cost (total power cost divided by net generation) increased by 17.54% from $57.04/MWh to $67.00/MWh. According to OVEC's 2021 annual report, "increased average power costs were directly related to reduced generation by the impact of COVID-19 on the energy demand."[15]

2.2 Introduction to AES Ohio

Applied Energy Services ("AES") operates in Ohio as AES Ohio. AES Ohio serves over 527,000 customer accounts, serving 1.25 million people in West Central Ohio through a network of over 1,682 miles of overhead and 8 miles of underground transmission lines.[16]

AES Ohio does business in Ohio as the Dayton Power and Light Company ("DP&L"), which is a subsidiary of DPL (DPL Inc.), which in turn is a wholly owned subsidiary of AES. DP&L is a public utility which sells, transmits, and distributes electricity to residential, commercial, industrial, and governmental customers in a 6,000 square mile area of West Central Ohio.[17]

Based on the ICPA, as a Sponsoring Company, AES Ohio (through DP&L) is entitled to a 4.9% contractual share of the costs and revenues of the two OVEC plants.[18] This Power Participation Ratio ("PPR") share is billed to AES Ohio customers in the LGR Rider.

2.3 The Inter-Company Power Agreement ("ICPA")

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 AEC's substantial power requirements. On October 15, 1952, a 25-year agreement was executed by OVEC and AEC. 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 Department of Energy ("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

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[12] OVEC. *Annual Report 2020*. p. 45. <https://www.ovec.com/FinancialStatements/2020-ConsolidatingFinancials.pdf>

[13] Ibid.

[14] Unless otherwise stated, all prices are in nominal US dollars.

[15] Ibid. p. 4.

[16] AES Ohio. "*Fast Facts*". Web. Accessed on November 18, 2021. < https://www.aes-ohio.com/fast-facts>

[17] Securities and Exchange Commission. *Dayton Power & Light Co.; DPL Inc*. Form 10-Q. September 2020. p. 14.

[18] Securities and Exchange Commission. *Dayton Power & Light Co.; DPL Inc*. Form 10-Q. September 2020. p. 5; OVEC. *Annual Report 2020*. p. 2. <https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf>

Agreement was terminated.[19] Since 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.[20] Shares of the sponsoring companies in OVEC's power participation benefits and requirements are shown in Figure 3.

Figure 3. OVEC Sponsoring Company Power Participation Ratios

Allegheny Energy Supply Company LLC[1]	3.01
Appalachian Power Company[6]	15.69
Buckeye Power Generating, LLC[2]	18.00
The Dayton Power and Light Company[3]	4.90
Duke Energy Ohio, Inc.[4]	9.00
Energy Harbor Corp	4.85
Indiana Michigan Power Company[6]	7.85
Kentucky Utilities Company[5]	2.50
Louisville Gas and Electric Company[5]	5.63
Monongahela Power Company[1]	0.49
Ohio Power Company[6]	19.93
Peninsula Generation Cooperative[7]	6.65
Southern Indiana Gas and Electric Company[8]	1.50
	100.00

Some of the Common Stock issued in the name of:

*American Gas & Electric Company
**Columbus and Southern Ohio Electric Company

Subsidiary or affiliate of:
[1]FirstEnergy Corp.
[2]Buckeye Power, Inc.
[3]The AES Corporation
[4]Duke Energy Corporation
[5]PPL Corporation
[6]American Electric Power Company, Inc.
[7]Wolverine Power Supply Cooperative, Inc.
[8]CenterPoint Energy, Inc.

Source: OVEC. *Annual Report 2020*. p. 2. < https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf>

The most recent legislation authorizing cost recovery with respect to changes under the ICPA arrangement (HB 6) requires that the cost to residential customers cannot exceed $1.50/month.[21] 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*

[19] OVEC. *Annual Report 2020*. p. 2. <https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf>

[20] Ibid.

[21] The Ohio Legislature. House Bill 6. October 2019. p. 15. <https://www.legislature.ohio.gov/legislation/legislation-summary?id=GA133-HB-6>

shall be recovered as determined by the commission subject to the monthly caps set forth in this division."[22] This means that, although 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 FirstEnergy Solutions bankruptcy impacted OVEC

A dispute starting in August 2018 which impacted the cost of the ICPA to AES customers came to a conclusion in 2020. The bankrupt FirstEnergy Solutions ("FES"), now Energy Harbor Corp., initially refused to pay its 4.85% (power participation ratio) PPR under the ICPA.

A settlement of the case became effective on June 15, 2020. Per the settlement, Energy Harbor:[23]

- assumed the ICPA;
- became a Sponsoring Company of OVEC, taking over FES's 4.85% PPR;
- continued to perform its obligations under the ICPA arising on or after June 1, 2020, pursuant to the terms of the ICPA; and
- paid OVEC $32.5 million in cash as full and final settlement of any cure amounts required to be paid in connection with the assumption of the ICPA.

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.*"[24] AES Ohio was allocated a portion of FES's energy output and paid the associated variable costs, and received without additional cost a portion of FES's capacity revenues.

2.5 AES and OVEC

In addition to AES Ohio's contract for OVEC generation through the ICPA, DP&L has other points of integration with OVEC. DP&L and OVEC have overlapping executive management. For example, the Vice-President and Chief Financial Officer of DP&L sits on the Executive Committees of both AES and OVEC.[25]

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[22] Ibid.

[23] OVEC. *Annual Report 2020*. p. 43. < https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf>

[24] Ibid. p. 42.

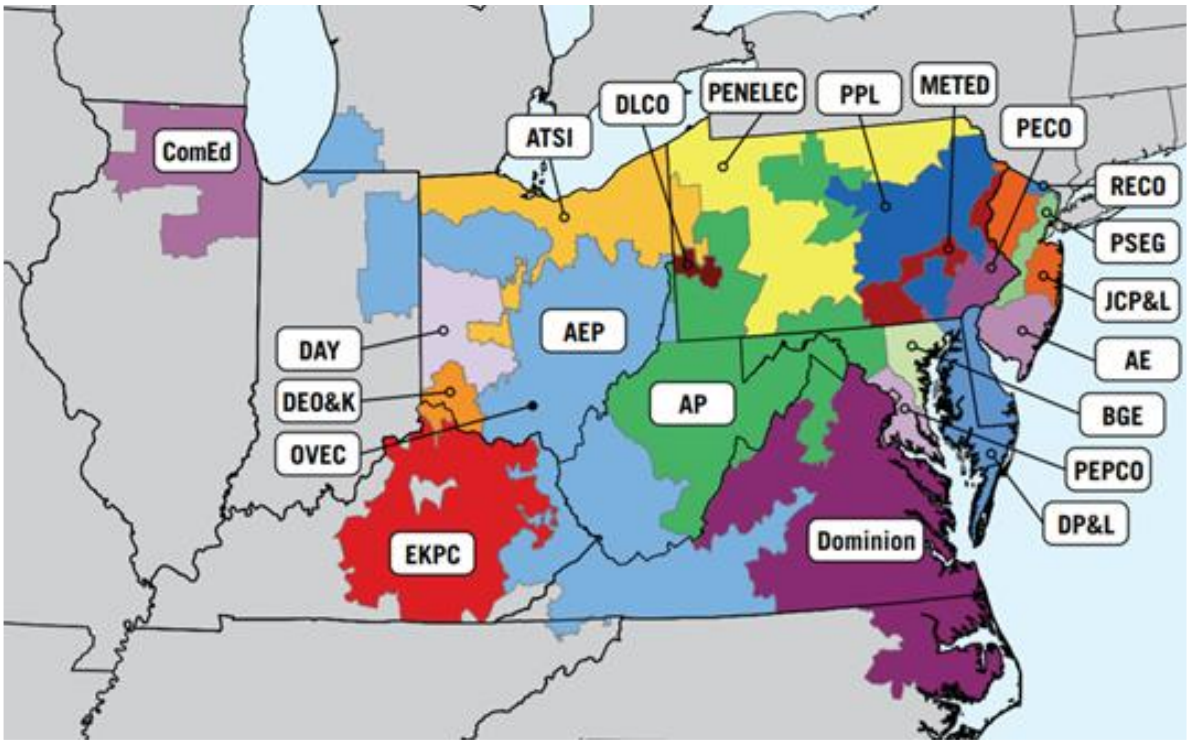
[25] OVEC. "Gustavo Garavaglia". Annual Report 2020. p. 46. < https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf>

3 Industry context

To understand LEI's assessment of the prudency of the costs incurred related to AES's LGR Rider, it is important to begin with the context of the electricity industry in PJM.

AES 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 and the District of Columbia (see Figure 4).[26]

Figure 4. PJM footprint



Source: Map of PJM territory served. <https://www.pjm.com/-/media/about-pjm/pjm-zones.ashx>

This chapter discusses the following:

- PJM energy and capacity markets;
- PJM ancillary services;
- PJM Minimum Offer Price Rule ("MOPR");
- LEI's estimated levelized cost of a new combined-cycle gas turbine ("CCGT") plantin PJM; and

[26] PJM coordinates the movement of electricity through all or parts Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia.

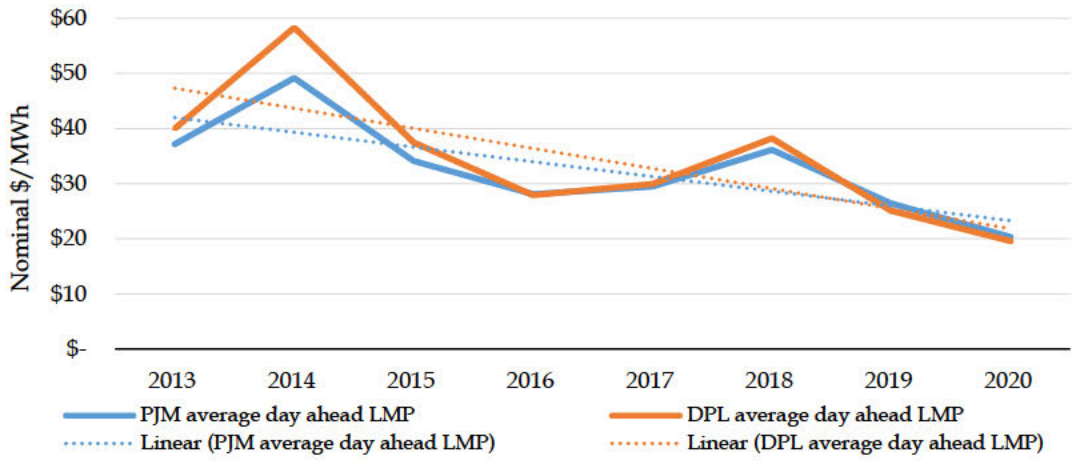
- Repeal of nuclear subsidy and introduction of solar subsidy in Ohio.

3.1 PJM energy and capacity prices

3.1.1 PJM energy prices

Wholesale electric energy prices have generally declined since 2013 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 2013 and 2020, day-ahead energy prices decreased on average 8.3% per year across the PJM footprint and fell on average 9.7% per year in AES (Dayton Power and Light "DPL" Company) zone (see Figure 5). The day-ahead energy prices in the AES zone averaged $25.06/MWh in 2019 and $19.55/MWh in 2020.

Figure 5. Annual average day-ahead energy prices (2013-2020)



Source: Day-ahead prices from PJM aggregated by S&P Global Market Intelligence.

3.1.2 PJM uplift payments

PJM provides payments for operating a unit under specific conditions as directed by PJM.[27] These uplift payments to units are intended to "ensure that they recover their total offered costs when market revenues are insufficient or when their dispatch instructions diverge from their dispatch schedule."[28] For example, if PJM wants to schedule a unit to operate for two hours at a given output (say, operate from 3pm – 5pm at 150 MW) the next day), but the unit requires four hours to start up, has a minimum run time of four hours, and a minimum generation level of 50 MW, then PJM would ensure that the costs of start-up and operations are reimbursed. i.e., that the unit's costs are made whole. This applies to units which are available based on economics, but

[27] PJM. "Drivers of uplift". https://www.pjm.com/markets-and-operations/energy/drivers-of-uplift

[28] Ibid.

not to units which are self-scheduled, because uplift payments are "*intended to be one of the incentives to generation owners to offer their energy to the PJM energy market for dispatch based on incremental offer curves and to operate their units at the direction of PJM dispatchers.*"[29]

3.1.3 PJM capacity prices

PJM has a capacity mechanism to support long-term reliability, conducting an annual three-year forward auction to procure the supply needed to meet predicted demand. The capacity mechanism is referred to as the Reliability Pricing Model ("RPM"). The RPM is a series of annual 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.[30] Capacity clearing prices in the BRA have fluctuated in recent years (see Figure 6). The 2022/2023 BRA is the third BRA for which PJM has procured only Capacity Performance ("CP") Resources, which means that the resources are required to generate if called upon, and if they do not, they must pay substantial penalties to PJM.[31] New entry, retirements, and changes in parameters affecting the demand curve impact capacity prices. The OVEC plants are located in the RTO capacity zone.

Figure 6. RPM base residual auction ("BRA") resource clearing price in PJM ($/MW-day)

	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
PJM	$ 16.46	$ 27.73	$ 125.99	$ 136.00	$ 59.37	$ 120.00	$ 164.77	$ 100.00	$ 76.53	$ 140.00	$ 50.00

Source: PJM. *2022/2023 RPM Base Residual Auction Results*. P. 1, 6. <https://www.pjm.com/-/media/markets-ops/rpm/rpm-auction-info/2022-2023/2022-2023-base-residual-auction-report.ashx>; PJM. *2021/2022 RPM Base Residual Auction Results*. p. 4; PJM. *2020/2021 RPM Base Residual Auction Results*. P. 1.

In the PJM auction held in May 2021 for the 2022/23 delivery year cleared at $50.00/MW-day.

3.2 PJM ancillary services

Ancillary services help to balance the transmission system as it moves electricity from generating sources to ultimate consumers. A co-optimized solution is performed by PJM to optimize between energy and/or ancillary services supplied from a unit by using market offers for energy and operating reserves as well as physical constraints.

Regulation and reserves are two categories of ancillary services for which PJM operates a market:

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[29] Monitoring Analytics. *PJM State of the Market Report 2020*. Section 4 : Energy Uplift. <https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2020/2020-som-pjm-sec4.pdf>.

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

[31] PJM. *2022/2023 RPM Base Residual Auction Results*. P. 26. <https://www.pjm.com/-/media/markets-ops/rpm/rpm-auction-info/2022-2023/2022-2023-base-residual-auction-report.ashx>.

- **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 compensation to those resources that can adjust output or consumption in response to an automated signal.

- **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, which is 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.

PJM operates a market for regulation services (the Regulation Market), and for reserves (the Synchronized Reserve Market, the Non-Synchronized Reserve Market, and the Day-Ahead Scheduling Reserve Market).[32]

There are ancillary services, which are not purchased or sold through a market-based system. For example, reactive power (which helps maintain the correct voltage on the transmission system and is essential to the flow of power) provided by generators is paid for by PJM based on a tariff, rather than procured through markets.[33]

In its Quarterly State of the Market Report posted on August 12, 2021, PJM's independent market monitor evaluated the synchronized reserve market for the first six months of 2021 and reported that it was not competitive due to high levels of supplier concentration.[34] During the same period, the Day-Ahead Scheduling Reserve Market and the Non-Synchronized Reserve Market were also reported by the PJM's independent market monitor as not competitive as the markets would have failed a three pivotal supplier test in 45.8% and 87.1% of the hours respectively.[35] PJM's independent market monitor recommended that PJM review the design of these markets to improve competitiveness.

3.3 PJM's minimum offer price rule ("MOPR")

The MOPR specifies a minimum dollar amount that a resource can offer into the capacity market. The MOPR is intended to prevent resources from offering into the market at artificially low prices, thereby limiting market power and ensuring that new resources are offered competitively into

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[32] PJM. *Learning Center - Regulation Market*. < https://learn.pjm.com/three-priorities/buying-and-selling-energy/ancillary-services-market/regulation-market.aspx>.

[33] PJM. *Reactive Supply Compensation Overview*. February 10, 2021. <https://www.pjm.com/-/media/committees-groups/committees/mic/2021/20210210/20210210-item-14-reactive-power-in-pjm.ashx>.

[34] Monitoring Analytics. *Quarterly State of the Market Report for PJM*. August 2021. p. 20.

[35] Ibid.

PJM's capacity markets. Historically, MOPR only applied to a limited number of new resources, such as natural gas-fired combustion turbine and combined cycle plants.

On December 19, 2019, FERC issued an Order expanding PJM's MOPR to include renewable energy resources, among other resources, benefitting from state subsidies (see text box below). The intent of expanding the MOPR was to mitigate the potential price-distorting impacts of state-subsidized resources participating in PJM's multibillion-dollar capacity market. Under the Order, all new and existing state-subsidized capacity resources would be subject to an administratively determined price floor. This ruling came as a response to a complaint filed against PJM in 2016 from a group of competitive power suppliers.[36]

The FERC Order was met with opposition from clean energy advocates, who argued that states with large renewable portfolios would have to pay twice for renewable capacity that does not clear PJM's market. Rehearing requests sought clarification of the definition of state subsidy, the scope of exemptions for existing renewables, and how the MOPR will be applied.

On March 18, 2020, PJM submitted its compliance filing to FERC. In this filing, PJM confirmed the price floors for various resources, and clarified exceptions to the MOPR. Notable exceptions to the MOPR 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.[37]

> "State Subsidy shall include "direct or indirect payment, concession, rebate, subsidy, non-bypassable consumer charge, or other financial benefit that is a result of any action, mandated process or sponsored process of a state government, a political subdivision or agency of a state, or an electric cooperative formed pursuant to state law" and
>
> 1) "is derived from or connected to the procurement of (a) electricity or electric generation capacity sold at wholesale in interstate commerce, or (b) an attribute of the generation process for electricity or electric generation capacity sold at wholesale in interstate commerce; or
> 2) will support the construction, development, or operation of a new or existing capacity resource; or
> 3) could have the effect of allowing the unit to clear in any PJM capacity auction."
>
> - PJM. "Compliance Filing Concerning the Minimum Offer Price Rule." March 18, 2020. p. 12.

On July 30, 2021, PJM filed an updated MOPR with FERC, intended to protect the market from buyer-side market power and from state actions that directly interfere with the auction clearing

[36] FERC Docket No. EL16-49-000.

[37] Hale, Z. PJM responds to FERC-ordered capacity market overhaul with tight timelines. S&P Global. March 18, 2020.

outcomes, while accommodating state public policies and self-supply models.[38] On September 29, 2021, FERC ordered that PJM's proposed amendments to its capacity market rules would take effect immediately and therefore, MOPR would come to effect for the upcoming 2023/2024 delivery year capacity auction.[39]

3.4 LEI's estimated levelized cost of new entry in PJM is lower than full cost of OVEC plants

LEI's analysis indicates that a new combined cycle gas turbine ("CCGT") has a levelized cost of energy ("LCOE") of $35.9/MWh for PJM West and $42.2/MWh for PJM East in 2021(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 and operating a new plant—including the fixed cost—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 a signal that an investor could earn an attractive return—it is, therefore, a signal to build a plant. If expected market prices are lower than the LCOE, it is a signal not to build a plant (unless there is an additional source of revenue, such as a capacity market). The LCOE of $35.9/MWh for PJM West and $42.2/MWh for PJM East include recovery of fixed costs of $120.4/kW/year and $128.2/kW/year.

The reported cost of the OVEC plants, at $67.00/MWh,[40] is higher than the levelized cost of building a new CCGT. The LCOE analysis implies that the OVEC plants are not competitive with a new CCGT based on full-cycle costs.

[38] FERC Docket No. ER21-2582-000.

[39] PJM. *PJM MOPR Proposal Takes Effect by Notice of FERC*. September 2021. < https://insidelines.pjm.com/pjm-mopr-proposal-takes-effect-by-notice-of-ferc/>.

[40] OVEC. "OVEC's average power cost to the Sponsoring Companies". Annual Report 2020. P. 4. < https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf >.

Figure 7. LEI's estimated cost of generic new entry of a CCGT in PJM

2021	CCGT (PJM West)	CCGT (PJM East)
Capital cost ($/kW)	$ 859	$ 922
Leverage (%)	60.0%	60.0%
Tax rate (%)	26.0%	26.0%
Debt interest rate (%)	6.0%	6.0%
Post-tax required equity return (%)	8.7%	9.0%
Equity contribution capital recovery term	20	20
Lead time	20	20
Heat rate (Btu/KWh)	6,339	6,339
Variable O&M ($/MWh)	$ 2.7	$ 2.1
Fixed O&M ($/MWh)	$ 24.0	$ 20.0
Fuel price ($/MMBtu)	$ 2.5	$ 3.3
Capacity factor (%)	80%	80%
All-in fixed cost ($/kW/year)	$ 120.4	$ 128.2
Levelized cost of new entry ($/MWh)	$ 35.9	$ 42.2

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. Forecasted gas price for PJM West is based on Dominion South while the gas price for PJM East is based on Transco-Z5. For the purpose of modelling, LEI has used average gas prices for 2020.

Sources: PJM MOPR Price Calculations, PJM BRA Parameters, LEI.

3.5 Repeal of nuclear subsidy in Ohio

The General Assembly of the State of Ohio amended substitute House Bill Number 128 ("HB 128"), which ended the $9/MWh subsidy paid to the state's nuclear plants.[41] HB 128 was passed on March 25, 2021, and effective June 30, 2021.[42] HB 128 also included a solar energy credit paid under section 3706.55 of the Revised Code, at $9/MWh. The total disbursements required under section 3706.55 of the Revised Code from the solar generation fund were set at $20 million. The bill reduced the monthly charge for residential customers to $0.10 per customer from $0.85 and the per-customer monthly charge for industrial customers was now capped at $242 per month, a significant decline from the previous $2,400 per month.[43]

[41] Sweeny, Darren. "Ohio House passes legislation to repeal nuclear subsidies." S&P Global. March 11, 2021.

[42] Ohio State Legislature. *Revise electric utility service law; repeal portions of HB 6*. House Bill 128. March 2021. <https://www.legislature.ohio.gov/legislation/legislation-summary?id=GA134-HB-128>

[43] Ibid.

4 OVEC bill and LGR Rider reconciliation

4.1.1 Scope

As note previously, as a Sponsoring Company, AES Ohio is responsible for a 4.9% contractual share (that of Dayton Power and Light) of the costs and revenues of the two OVEC plants, based on the ICPA.[44] The total 4.9% share is billed to AES Ohio customers in the LGR and is therefore within the scope of this audit.

This chapter addresses the following topics:

- details of the monthly OVEC bills from January 2020 to December 2020[45] in which all the charges and credits to AES Ohio and the other members of the ICPA are detailed; and
- the LGR Rider, which details the forecasted monthly charges to AES Ohio's customers, the actual monthly LGR charges, and the cumulative unrecovered balance in the LGR Rider.

In coming to LEI's conclusions, LEI issued formal data requests and held conference calls and phone calls with AES Ohio personnel.

4.1.2 Background of LGR

AES Ohio's LGR became effective January 1, 2020.[46] It replaced AES Ohio's Reconciliation Rider, which was in effect from November 1, 2018, to December 31, 2019. As noted previously, in 2019 HB 6 defined a legacy generation resource in a way which encompassed the OVEC plants (RC 4928.01(A)(41)). The LGR Rider was implemented on January 1, 2020, and became effective on that date. LGR Rider rates are updated every six months and are effective for a six-month period (January 1 through June 30; and July 1 through December 31, in a given year). When the rates are set for the coming half-year, the rates are also trued-up for the previous half-year. This process applies to all the EDUs which buy energy and capacity from OVEC and are allowed to recover the cost on the LGR Rider

4.2 Evaluative criteria

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

- Are AES Ohio's journal entries consistent with OVEC monthly bills?

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[44]LEI DR 06-001 - Attachment 1.pdf *(Amended and Re-Stated Inter-Company Power Agreement)*

[45] LEI DR 02-009 - Attachment 1 - CONFIDENTIAL ("OVEC bill").

[46] AES Ohio Tariff, issued December 27, 2019, pursuant to Finding and Order in case No. 19-2133-EL-ATA

- Are the actual monthly LGR charges, which appear in the Rider statements, consistent with the monthly bills provided by OVEC, which AES Ohio pays?
- On a net basis, does the ICPA cost customers more than the plants earn in the PJM markets?
- Are the under/(over) recovery balances consistent with monthly OVEC costs and revenues?

4.3 Findings and conclusions

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

AES Ohio provided its monthly OVEC bills and accounting entries, and LEI examined each month in 2020.

4.3.1.1 Analysis of OVEC actual charges

LEI examined AES Ohio's journal entries for actual OVEC charges, provided in LEI DR 06-005 Attachment 1 CONFIDENTIAL and LEI DR 06-003 Attachment1_Part2.pdf (confidential) and compared them to the OVEC monthly bills provided LEI DR 02-009 Attachment 1 CONFIDENTIAL ("OVEC bill").

The total of payments from the journal (Pmt 1 + Pmt 2 + Pmt 3 in Figure 8) sum to the total actual cost on the OVEC bill. This means the OVEC bills and AES Ohio's journal entries are consistent, as they should be.

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

[redacted]

Source: LEI DR 02-009 - Attachment 1 - CONFIDENTIAL ("OVEC bill"), LEI DR 06-005 Attachment 1 CONFIDENTIAL ('journal entries"), and LEI DR 06-003 Attachment1_Part2.pdf (confidential).

LEI next reconciled journal entries with the actual LGR charges. LEI examined LEI DR 06-005 Attachment 1 CONFIDENTIAL ('journal entries") generated by AES Ohio's customers billing system and compared them to the LGR Rider charges shown in LEI-DR-06-002 Attachment 1. Net of the CAT tax, the entries reconciled to within a few dollars (see Figure 9).

Figure 9. Reconciliation of journal entries and rider charge

Source: LEI DR 06-005 Attachment 1 CONFIDENTIAL (journal entries), and LEI-DR-06-002 Attachment 1

4.3.1.2 Recommendations

LEI concludes that the OVEC bills, journal entries, and the actual charges on the LGR bills are consistent with one another. LEI has no recommendations on this topic.

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 AES Ohio, including depreciation, debt service, and plant maintenance expense. These fixed costs comprise the demand charges in the OVEC bill.

4.3.2.1 Analysis of billing of fixed cost

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 (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 Column H of Figure 10.

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

Source: LEI DR 02-009 - Attachment 1 - CONFIDENTIAL ("OVEC bill")

Next, LEI calculated AES Ohio's share of the total OVEC demand charges in the following manner: AES Ohio's share of OVEC demand charges is equal to its PPR of 4.9%. Its share of the PJM charges is 5.42% (the share of PJM charges is higher than the share of demand charges because some of the Sponsoring Companies are not in PJM). Multiplying the PPR share by the total demand charges in Figure 10 gives the demand charges that should be billed to AES Ohio; for example, for January 2020, the total demand charge to AES Ohio was [redacted] (Column A in Figure 11). Multiplying AES Ohio's PJM percentage share by total OVEC PJM charges (or credits) results in a PJM charge of [redacted] for January 2020 (Column B in Figure 11). To reconcile the total OVEC charges with AES Ohio's journal, AES Ohio's share of OVEC transmission charges ([redacted]) must also be added (Column C of Figure 11). The total of these components is shown in Column D of Figure 11. The entries in Column H show reconciliation to within several cents per month of demand charges paid based on AES Ohio's journal. This is a tiny difference and is not an issue. The only exception is for the month of October 2020, when the amount of [redacted] appears in the reconciliation column. This is because the OVEC bill included [redacted] to correct a PJM billing error in August 2021, and is not an error on the part of AES Ohio.

Figure 11. Total demand charges payable to OVEC from AES Ohio, reconciled with journal

Source: Columns A - D, LEI DR 02-009 - Attachment 1 - CONFIDENTIAL ("OVEC bill"); Columns E and F, LEI DR 06-005 - Attachment 1 - CONFIDENTIAL ("journal entries")

*The OVEC bill separates the PJM capacity charge from the demand charges, but AES includes it, so LEI adjusted for that here, to ensure OVEC and AES journal would reconcile accurately.

**The amount of [redacted] appears in the reconciliation column for October 2020, because the OVEC bill included [redacted] to correct a PJM billing error in August 2021.

4.3.2.2 Recommendations

The components of fixed costs were billed properly, and LEI has no recommendations.

LEI notes that Component (D) of the demand charge, defined as [redacted][47] amounts to [redacted] million per year which is ultimately paid by ratepayers including AES Ohio's customers. Though it is not a large share of the overall OVEC bill to ratepayers, the [redacted] million per year amounted to nearly all OVEC's [redacted] million of net income in 2020.[48]

4.3.3 The OVEC plants cost more than they earn

Although it is obvious from the fact that the LGR is usually a charge to AES Ohio's customers and not a credit, it is helpful to set the costs of the OVEC plants in the context of the PJM energy and capacity markets.

4.3.3.1 Analysis

During the audit period, LEI calculated that the monthly average cost of OVEC demand charges as [redacted]/MWh; and energy charges as [redacted]/MWh, for a total cost for the year of [redacted]/MWh (see Figure 12). LEI calculated these numbers by summing together the total OVEC demand and

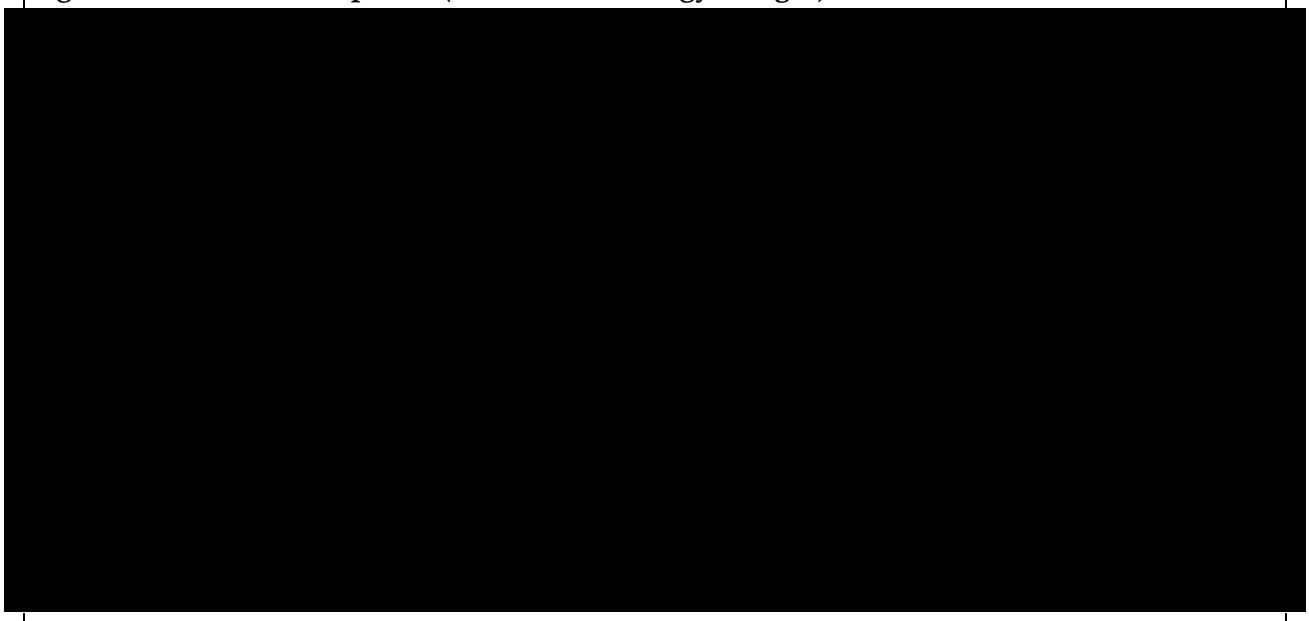
[47] LEI DR 02-009 - Attachment 1 - CONFIDENTIAL ("OVEC bill")

[48] OVEC. *Annual Report 2020*. https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf

energy costs (in dollars), and then dividing by the total available energy used to bill the Sponsoring Companies (in MWh).

LEI's results are consistent with reporting by OVEC, which noted: "*In 2020, OVEC's average power cost to the Sponsoring Companies was $67.00 per MWh compared with $57.04 per MWh in 2019... Increased average power costs were directly related to reduced generation by the impact of COVID-19 on the energy demand*.[49]

Figure 12. OVEC cost of power (demand and energy charges)



Source: LEI DR 02-009 - Attachment 1 - CONFIDENTIAL ("OVEC bill")

The net impact on AES Ohio and its customers depends on the OVEC plants energy market earnings and on AES Ohio's capacity market revenues (AES Ohio's capacity market bidding is discussed in detail in Section 5). Capacity market earnings help offset AES's total OVEC bill (energy plus demand) in 2020 of [redacted]; it leaves an estimated [redacted] to be recovered for the year (see column C in Figure 13). AES Ohio recovered a portion of this, [redacted] through its share of OVEC's energy sales in the PJM market (column D in Figure 13). The remaining [redacted] is a loss to AES Ohio, that is reflected in the LGR Rider. The weighted average cost per MWh of this loss was [redacted]/MWh in 2020.

[49] OVEC. *Annual Report 2020*. P. 3. https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf

Figure 13. The cost of OVEC generation to AES Ohio

Sources: LEI DR 02-009 - Attachment 1 - CONFIDENTIAL ("OVEC bill"), LEI-DR-06-003 Attachment 1 Part2.pdf, LEI-DR-06-003 Attachment 1 Part1.pdf, and LEI-DR-06-003 Attachment 3

This conclusion is consistent with LGR rider. OVEC invoices AES Ohio for AES Ohio's entitlement to the output of the plants. AES Ohio sells this entitlement into PJM, which results in a net deficit. The difference is billed to AES Ohio's customers through the LGR rider.

4.3.3.2 Recommendations

The current ICPA does not expire until June 30, 2040. AES Ohio's customers could be locked into paying a premium for energy and capacity from the OVEC plants in future years, though market prices could change in the future, so it is possible that the premium could become a discount. Commission may wish to re-examine the role of Component D, which appears to LEI to be a return to capital.

4.3.4 LGR Rider reporting components

As a result of the passage of HB 6, the RR Rider terminated on December 31, 2019. The LGR Rider was implemented on January 1, 2020 and became effective on that date. The current audit period covers the calendar year 2020, therefore, the LGR Rider cost covered in the audit includes the period from January 1, 2020, to December 31, 2020.

The LGR Rider features two parts, the second of which in turn consists of two parts:

- Part A (the statewide rate) is the LGR cost for the next six months. This cost is a projection based on estimates provided by individual companies and then rolled up for a state-wide total; and
- Part B (a rate particular to each EDU) which represents the true ups from estimated costs to actual costs. Part B also includes true-ups from the RR, which was in effect until December 2019.

Parts B is the focus of the audit, because it covers actual costs (rather than projected costs). AES Ohio provided its calculations of costs and cumulative balances in AES Ohio in LEI-DR-06-002 –

Attachment 1, LEI verified that the rates AES Ohio used were consistent with the rates published in AES Ohio's LGR Rider tariffs.[50]

4.3.5 Analysis of cumulative balances

The cumulative under-recovery of the RR balance as of December 2019 was $[redacted] (the last column of Figure 14). The [redacted] balance was not collected at all in the first half of 2020 because the new LGR Rider was not in effect yet. The balance began to be collected in the LGR Rider beginning in July 2020. By the end of December 2020, the RR unrecovered balance was very small, at [redacted].

Figure 14. Part B of AES Ohio's Rider LGR 2020 (RR final true-up)

[redacted]

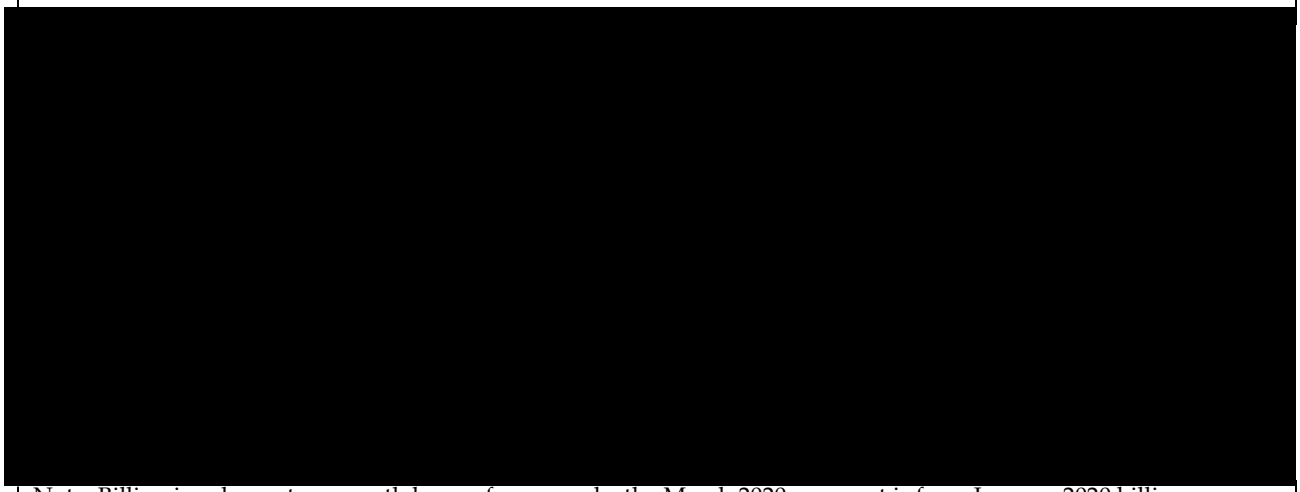
Source: LEI-DR-06-002 – Attachment 1

In Figure 15 below, AES Ohio provided its net (gains)/losses on the OVEC contract (see first column). LEI verified that these net (gains)/losses correspond to the journal entries in LEI-DR-06-003-Attachment 3_Dec 2020.pdf (p 4 of 18), referred to in that document as "net costs," in which the OVEC costs are offset by PJM revenues.

To arrive at monthly under/(over) recovery for each month, net cost (aka net (gains)/losses) revenues from the LGR Rider (from residential and commercial customers, and revenues from AES Ohio's share of FirstEnergy's entitlement) are subtracted. The last column in Figure 15 shows the sum of cumulative under/(over) recovery of the LGR Rider and the cumulative under/(over) recovery of the RR.

[50] AES Ohio Tariff, No. D40, Fifth Revised Sheet, effective January 1. 2020, and Sixth Revised Sheet effective July 1, 2020.

Figure 15. Part B: Actual cost and cumulative actual cost of AES Ohio's Rider LGR 2020



Note: Billing involves a two-month lag, so for example, the March 2020 payment is from January 2020 billing.
Source: LEI-DR-06-002 – Attachment 1, tab "LGR template for tracking," and LEI-DR-06-003 Attachment 3_Dec 2020.

4.3.5.1 Recommendations

LEI found the LGR cumulative balances are consistent with OVEC actual costs and journal entries and has no recommendations.

5 Disposition of energy and capacity

5.1 Scope and background

5.1.1 Scope

OVEC's generation offer practices and outcomes impact AES 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
- offers into the energy, capacity, and ancillary service markets.

In coming to LEI's conclusions, LEI issued formal data requests, talked with AES Ohio 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*";[51] 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*."[52]
- **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

[51] "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>

[52] Ibid.

for which they are committed. They also commit to serve PJM's emergency needs whenever called upon.[53]

- **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.[54]

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 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 "*the latest practices and procedures with regard to energy scheduling and consistently apply standard work procedures to ensure efficiency and economy in the operation of the department – including applicable PJM requirements*."[55]

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[53] 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>

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

[55] LEI-DR-01-008.

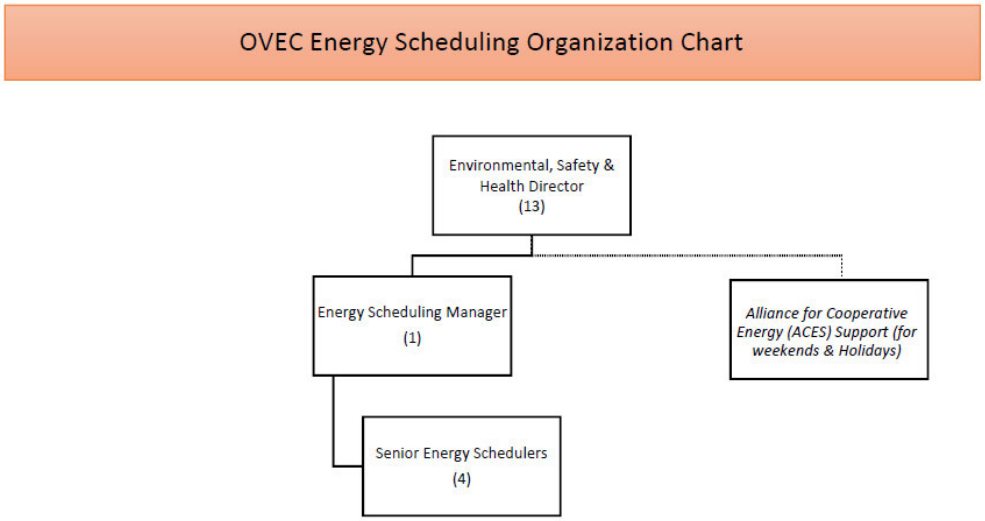
There is one Energy Scheduling Manager in the Energy Scheduling Department and four senior Energy Schedulers (see Figure 16).[56]

- 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. The energy is offered in accordance with the terms of the Inter-Company Power Agreement, consistent with approved Operating Committee Procedures and PJM market requirements; 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]
- The Alliance for Cooperative Energy ("ACES") is a third-party contractor that provides energy scheduling support services during weekends and holidays.

[56] LEI-DR-01-008 – Attachment 1.

[57] LEI-DR-01-008.

Figure 16. OVEC Energy Scheduling Organization Chart



Note: There were no position vacancies in 2020.
Source: LEI-DR-01-008-Attachment 1.

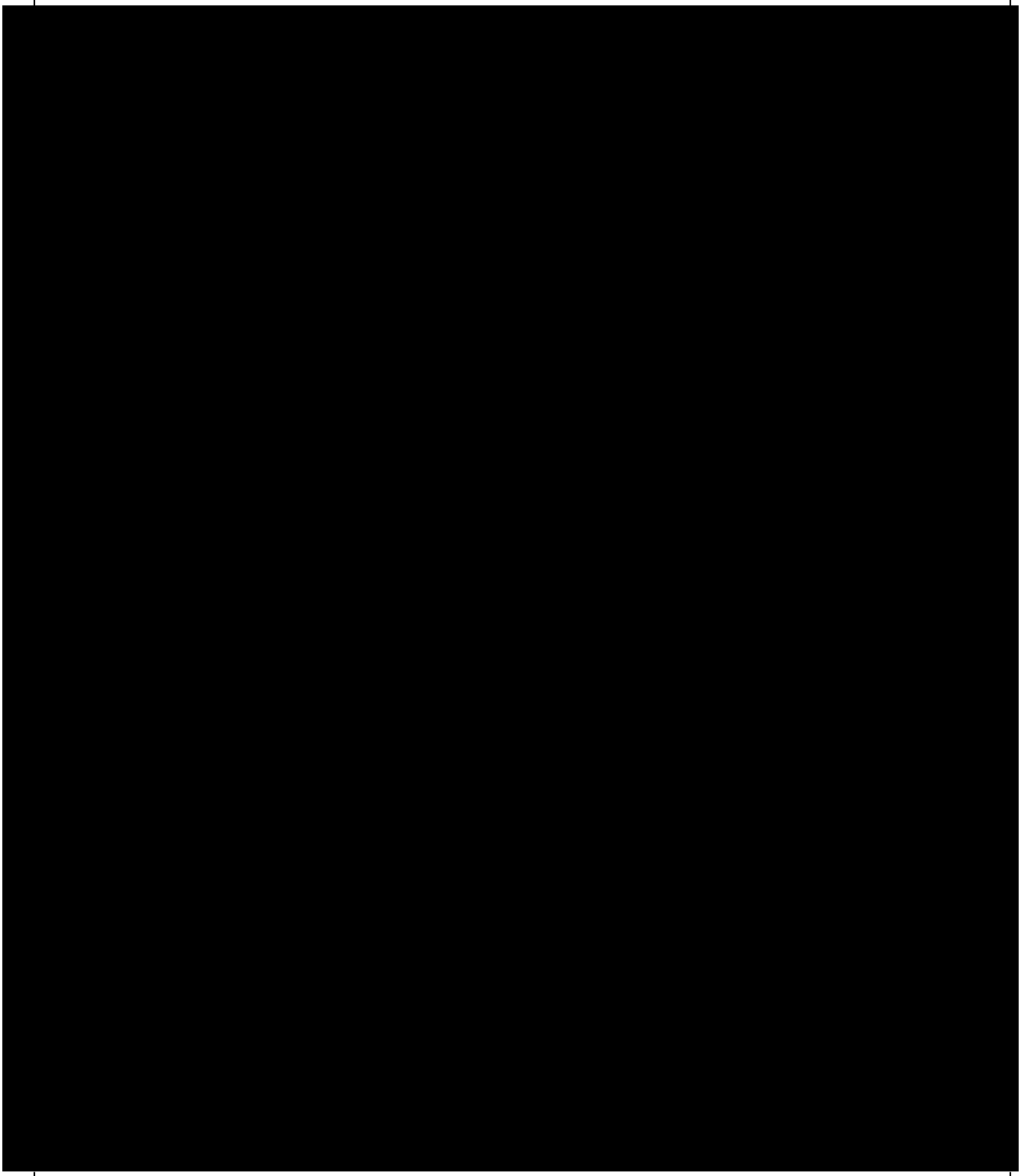
5.3.2 OVEC's processes for placing offers into the PJM energy markets

OVEC's energy must be offered in accordance with the terms of the ICPA, and 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 de-rates, potential unit liabilities, outage status, and expected unit return-to-service dates (see Figure 17). 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 and the information in the status report is updated during the morning calls based on real-time unit operating status. 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-01-003 – Attachment 1 – Confidential.

Figure 17. OVEC normal daily scheduling timeline



Source: LEI-DR-01-005_Confidential_Attachment_1 (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 "*[t]his report is also 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 AES 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.[60]

OVEC has typically self-scheduled all but one of the units (i.e., it offered them as "must-run") in accordance with the OVEC Operating Committee procedures, as approved by the Operating Committee. [redacted]. "[61]

From the time OVEC joined PJM in 2018 until 2020, OVEC's strategy for the Kyger Creek and Clifty Creek units (except for Clifty Creek Unit 6) was to self-schedule the resource, which was consistent with the sponsor-approved Operating Committee procedures, to make sure the units were in service and available for dispatch in the DA market. The only time that this was not done was [redacted][62]
Unit 6 at Clifty Creek was the only unit that was not self-scheduled; it was (and is) offered based on economics during summer ozone non-attainment periods.[63]

[59] LEI-DR-01-003 – Attachment 1 – Confidential.

[60] LEI-DR-01-001.

[61] LEI-DR-01-005_Confidential_Attachment_1: OVEC Operating Procedures effective November 15, 2019.

[62] LEI-DR-01-003.

[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.

In 2020, owing to low energy prices, OVEC units were committed on an economic basis, rather than self-scheduled (i.e., offered as "must run") temporarily, from April 14, 2020 through June 30, 2020.[64]

LEI recommends that AES Ohio and the other members of the Operating Committee allow this flexibility on an ongoing basis. Financial risk is minimal because if a unit is offered based on economics and PJM needs to dispatch it, PJM will provide uplift payments to make whole the entire cost of operation (as discussed previously). Therefore, ideally, the units would be committed based on economics all or most of the time. However, coal plants are generally not designed for this kind of operation, and repeated start-up of coal plants can damage equipment. Periods of non-operation also cause difficulties in managing staffing and fuel deliveries

5.3.4 AES Ohio's engagement in the OVEC Operating Committee

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 to OVEC's Board of Directors when other problems arise which may affect the transactions under the ICPA. In order to reach a decision, the 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]

AES Ohio confirmed that the OVEC Operating Committee held one in-person meeting and one conference call in 2020. AES Ohio appointed representatives to participate in all the meetings (see Figure 18).

[64] 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.

[65] LEI-DR-06-001_Attachment_1

[66] LEI-DR-06-001_Attachment_1

Figure 18. AES Ohio's participation in OVEC Operating Committee meetings in 2020

Meeting date	Meeting type	DEO's representatives in attendance	Subject
April 14, 2020	in-person	1	Discuss providing OVEC the ability, on a temporary basis (to May 31, 2020), to offer the units economic or must run due to direct and indirect impacts of COVID-19 pandemic
May 6, 2020	virtual	1	OVEC Operating Committee annual meeting

Source: LEI-DR-01-006.

The OVEC Operating annual meeting held on May 6, 2020, covered a variety of topics such as DOE Arranged Power Agreement Termination and System Reconfiguration Update, fuel updates and coal strategy, participation in the PJM regulation market, review of economic offers, ACES updates, environmental compliance update, power costs, and review of operational and financial performance and transmission revenue (see Figure 20). 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. Figure 19 shows the operational and financial performance data presented in the 2020 OVEC Operating annual meeting. The minutes of the meeting were recorded by a Committee Chair-appointed Recording Secretary and saved in an electronic format.[67]

Figure 19. OVEC operational and financial performance - 2020 OVEC Operating annual meeting

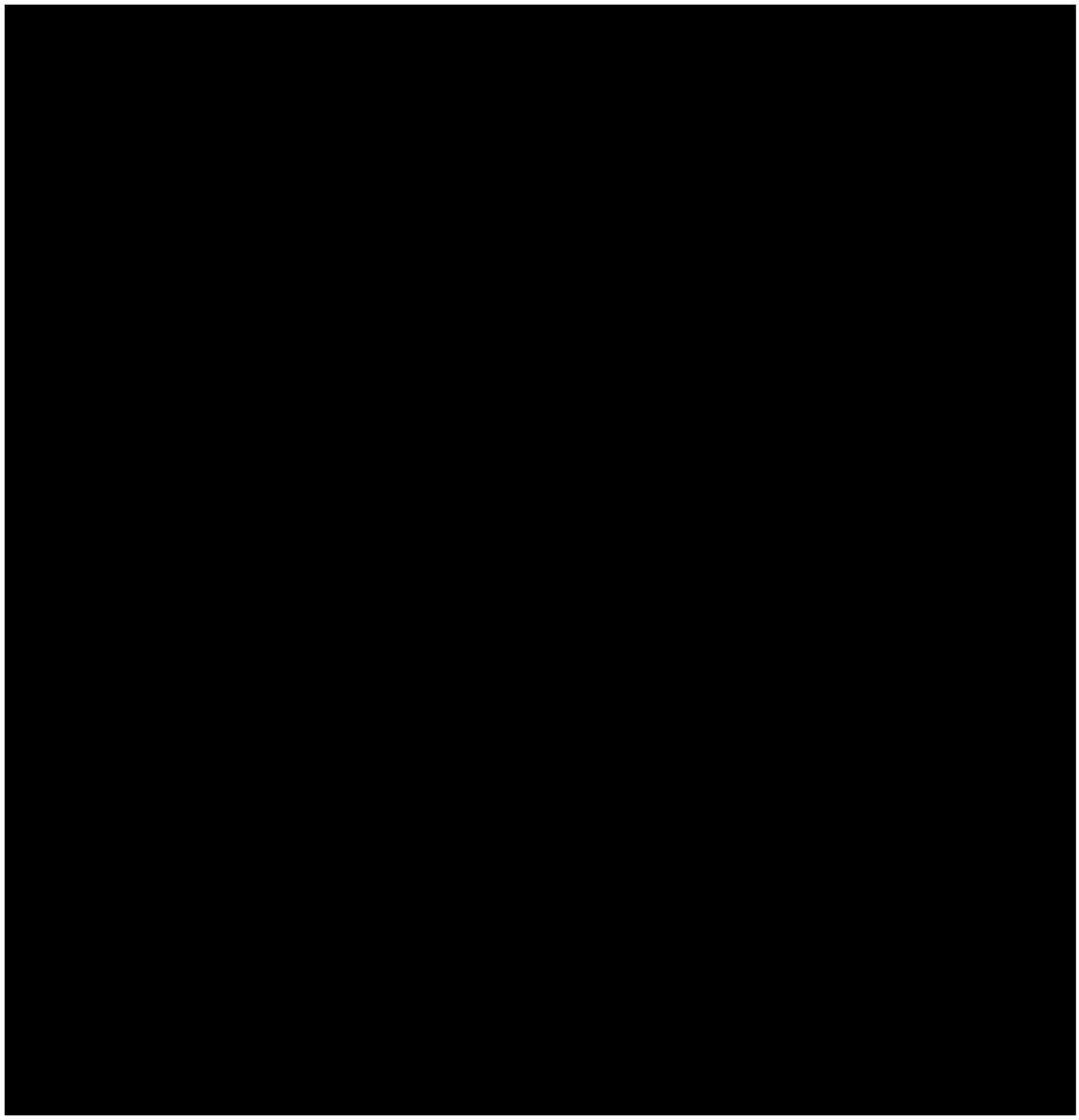
Source: LEI-DR-01-006_Confidential_Attachment_2.

LEI believes AES Ohio is well represented in OVEC Operating Committee's meetings with active engagement and meeting notes that were appropriately documented.[68]

[67] LEI-DR-01-011.

[68] LEI DR 01-006 – Attachment 2 – Confidential.

Figure 20. OVEC Operating Committee May 6,2020 agenda and notes



Source: LEI-DR-01-006_Attachment_1.

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 subscribe to various PJM email lists associated with the stakeholder groups for additional awareness of

ongoing events and updates at PJM. Sponsoring Companies also contact OVEC to ensure that OVEC is aware of any applicable changes that may affect its operations in the PJM market.[69]

5.3.6 Capacity market

AES Ohio, through its ownership share of OVEC, offered capacity into the PJM annual BRA auctions, for the RTO Locational Delivery Area ("LDA") during the audit period of January 1 through December 31, 2020.[70] As noted previously, the BRA capacity auctions are held three years before the delivery year.

AES Ohio, as an RPM entity, must offer in the capacity market all the available capacity on the OVEC units, according to PJM rules. AES Ohio offered its OVEC share as a Capacity Performance ("CP") resource[71] into the 2019/2020 BRA and the 2020/2021 BRA.[72] These auctions were held in 2016 and 2017.

AES Ohio's strategy for the 2020/21 BRA [redacted][73] In the 2020/21 BRA, AES Ohio offered a total of [redacted] (see Figure 21), compared to [redacted] in the 2019/2020 BRA.[74] LEI believes this strategy could be improved upon. It does not leave open the opportunity to earn bonus payments for over-performance during PJM's performance assessment hours ("PAH"), because it involves offering all the OVEC capacity that belongs to AES Ohio. LEI recommends that AES Ohio consider developing price and volume offer pairs based on analysis of bonus payments and penalties at various MW offer levels.

[69] LEI DR-01-007.

[70] LEI DR-01-013.

[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 01-002 – Attachment 1 and LEI DR 01-002 – Attachment 2.

[73] LEI DR 01-014 – Attachments 1 and 2.

[74] LEI DR 01-015 – Attachments 1, 2, 3, and 4.

Figure 21. AES Ohio's capacity performance price ($/MW-day) and volume (MWs) offer in 2020/2021 BRA auction

Planning Period	Auction Type	Resource Name	Resource Type
2020/2021	BASE	CLIFTY CREEK 1 OVEC PSEUDO TIE	GEN
2020/2021	BASE	CLIFTY CREEK 2 OVEC PSEUDO TIE	GEN
2020/2021	BASE	CLIFTY CREEK 3 OVEC PSEUDO TIE	GEN
2020/2021	BASE	CLIFTY CREEK 4 OVEC PSEUDO TIE	GEN
2020/2021	BASE	CLIFTY CREEK 5 OVEC PSEUDO TIE	GEN
2020/2021	BASE	CLIFTY CREEK 6 OVEC PSEUDO TIE	GEN
2020/2021	BASE	KYGER CREEK 1 OVEC PSEUDO TIE	GEN
2020/2021	BASE	KYGER CREEK 2 OVEC PSEUDO TIE	GEN
2020/2021	BASE	KYGER CREEK 3 OVEC PSEUDO TIE	GEN
2020/2021	BASE	KYGER CREEK 4 OVEC PSEUDO TIE	GEN
2020/2021	BASE	KYGER CREEK 5 OVEC PSEUDO TIE	GEN

Source: LEI DR 01-015 – Attachments 3 and 4.

The BRA clears based on the highest-priced unit needed to meet demand ("pay as cleared").[75] In the PJM 2019/2020 and 2020/2021 BRAs, all of AES Ohio's capacity cleared the market because the offer price was lower than the clearing price in the PJM RTO zone of $100.00/MW-day for 2019/2020 and $76.53/MW-day for 2020/2021.

Figure 22. 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 construct is evolving as PJM continuously evaluates the markets it administers. AES Ohio should keep monitoring developments in the capacity market.

5.3.7 Ancillary services

In PJM, some A/S are provided by resources by default, based on the unit being online and integrated into the PJM system. These A/S are Synchronized Reserve, Day-ahead Scheduling Reserve, and Balancing Operating Reserve associated with units that are online, but not fully loaded.[76] Units are paid if these services are called upon by PJM, but the unit owners do not make specific A/S offers. Other A/S are provided in separate markets, as detailed previously in Section 3.

AES Ohio earned revenues in 2020 by supplying Synchronized Reserves and Day Ahead Scheduling Reserves. It incurred charges for Balancing Operating Reserves (see Figure 23). AES

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

[76] LEI-DR-01-004.

Ohio received 4.9% of the cleared and deployed ancillary services charges and credits from OVEC units during the audit period, consistent with its PPR as defined in the OVEC ICPA [77]

Figure 23. Prorated monthly AES Ohio A/S net earnings

Source: LEI-DR-01-018 – Attachment 1 – Confidential.

OVEC hired a third-party consultant to conduct a study (which is in progress) and provide recommendations on the risks and potential opportunities of OVEC's participation in additional ancillary services markets, such as regulation.[78] A final report is expected to be issued in the first quarter of 2022.[79]

5.3.8 OVEC variable costs versus energy prices

There were times in 2020 during which PJM DA prices did not cover the variable costs of running the plants. Under such circumstances, units which are self-scheduled incur losses for their owners; but economically committed units would receive an uplift payment to cover costs if day-ahead prices do not cover variable costs, as noted previously. LEI examined all twelve months in 2020; on a monthly average basis, PJM prices at the Dayton Power & Light ("DPL") hub were lower than OVEC energy charges most months in 2020, with the exception of July and December (see Figure 24).

[77] LEI-DR-01-010.

[78] LEI-DR-01-004.

[79] LEI-DR-01-016.

Figure 24. OVEC energy charges and average PJM market prices at DPL hub

Month	OVEC energy charge ($)	Available energy (billing kWh)	Energy cost per MWh	PJM energy price per MWh	PJM price less OVEC energy cost
January 2020	$	[redacted]			
February 2020	$				
March 2020	$				
April 2020	$				
May 2020	$				
June 2020	$				
July 2020	$				
August 2020	$				
September 2020	$				
October 2020	$				
November 2020	$				
December 2020	$				

Source: LEI-DR-02-009_CONFIDENTIAL_Attachment_1 and third-party data provider (DPL Day Ahead LMP - Monthly Average).

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 and AES Ohio have multiple channels to actively participate in the PJM market developments and are well informed of the PJM market.

LEI makes the following recommendations:

- **Must-run offer strategy:** LEI believes the changes to OVEC's must-run strategy due to low energy prices in 2020 were prudent. AES Ohio should encourage the Operating Committee to allow OVEC the option to commit available units based on must-run or economics on an ongoing basis. Based on cost information (start-up costs, minimum run time, etc.) that OVEC would provide to PJM, PJM would dispatch the resource if it is economic. Ideally, the units would be committed based on economics all or most of the time, but LEI is aware that this can be an issue for coal plants, which are designed to operate continuously. Thus, LEI would not expect to see the plants offered based on economics all the time, but the option to do so provides additional flexibility and could reduce costs for customers.
- **OVEC Operating Committee:** LEI recommends that AES Ohio encourage the OVEC Operating Committee meetings to be held more frequently to receive more timely updates on each plant's operating performance, cost of service, and profit/loss statements for market-based revenues derived from the PJM markets.
- **Offer strategy in PJM capacity auctions:** As noted above, AES Ohio should consider developing price and volume offer pairs based on analysis of bonus payments and penalties at various MW offer levels. This will explicitly recognize the value of the opportunity to earn bonus payments for over-performance during PAHs.

- **Ancillary service market:** LEI notes that OVEC is evaluating the pros and cons of supplying Regulating Reserves in the PJM market. LEI agrees this will be a useful evaluation..

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 AES Ohio's customers. American Electric Power ("AEP"), OVEC's largest Sponsoring Company, provides coal procurement and related services for OVEC, via its American Electric Power Service Corporation ("AEPSC") subsidiary.[80] AEPSC's regulated Fuel Procurement organization has the responsibility for coal procurement, coal transportation and logistics, as well as coal inventory policy and inventory management for the Kyger Creek and Clifty Creek power stations.[81] These procurement practices and outcomes impact AES Ohios'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.

In coming to LEI's conclusions, LEI issued formal data requests, attended a virtual site visit, and conducted additional research.

6.1.1.2 Background

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

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

[80] LEI-DR-02-001 – Attachment – 1.

[81] LEI-DR-02-001 – Attachment – 1.

6.1.2 Evaluative criteria

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

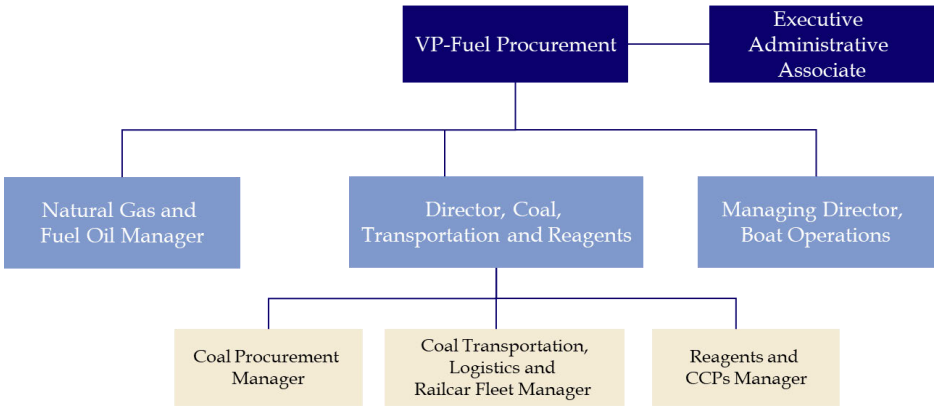
1. Does the coal procurement process provide for sufficient visibility and executive attention?
2. Does OVEC project future deliverability needs and adjust its portfolio to take advantage of new opportunities and/or avoid potential risks?
3. Does OVEC have a strategy in place to maintain a reliable coal 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 AEPSC'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 Vice President ("VP") of fuel procurement, who reports to the Senior Vice President ("SVP") of the Commercial Operations organization of AEPSC (see Figure 25).

Figure 25. AEPSC regulated Fuel Procurement organization



Source: LEI-DR-02-001 – Attachment – 1 ("American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018").

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."* [82] 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."[83]

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.*"[84] In terms of long-term procurement planning, the regulated FP works with groups such as the Corporate Planning and Budgeting organization which is responsible for developing the Integrated Resource Plan ("IRP"). In addition, the regulated FP organization provides support for fuel-related regulatory activities in response to state and federal agency requirements.[85]

In the regulated FP organization, the VP has the ultimate responsibility to make sure the OVEC plants 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.[86] 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 considers changes to the regulated Fuel Procurement Policy and Procedures.[87]

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[82] Regulated Fuel Procurement Organization. LEI-DR-02-001 – Attachment – 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[83] Ibid.

[84] Ibid.

[85] "General administrative duties." LEI-DR-02-001 – Attachment – 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[86] Ibid.

[87] "General administrative duties." LEI-DR-02-001 – Attachment – 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

6.1.3.2 Coal procurement strategy

As noted previously, AEPSC procures coal and establishes coal procurement strategy for OVEC. AEPSC's overall FP Policy is to [redacted]"[89]

The strategy specifies coal procurement targets for Year 1 through 5 (see Figure 26) based on OVEC management's forecast. The coal procurement targets are reviewed by OVEC management on an annual basis. For Kyger Creek, the coal is primarily sourced from the [redacted]. OVEC characterizes its strategy with respect to Kyger Creek as [redacted]. Clifty Creek has more options for suppliers from [redacted]. OVEC's strategy for Clifty Creek, therefore, involves [redacted].

Figure 26. Coal procurement targets

[redacted]

Source: LEI-DR-02-001 – 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 coal burn forecast is prepared utilizing a variety of data, such as the delivered cost of fuel, projected generation, fuel handling costs, consumable costs, scheduled outages, and other reliability factors including forced outage rates. The coal forecast projects monthly consumption for 5 years and is typically updated bi-annually. The results of the forecast could indicate the need for a Request for Proposal ("RFP") depending on inventory levels and committed purchases for the current

[88] "Regulated FP considerations." LEI-DR-02-001 – Attachment – 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[89] Ibid.

year and future years.[90] For the near term (upcoming year), forecasts are prepared year during the annual budgeting process and finalized in November, then updated in June or July, in the middle of the budget year. Figure 27 and Figure 28 show forecasted coal burns compared with actual coal burns. Coal volume burned at both plants was consistently lower than the forecast.

Figure 27. Actual coal consumed versus monthly forecast estimate, Clifty Creek

Source: LEI DR 02-007 - Attachment 1 and LEI DR 02-021-Attachment 1 – Confidential.

Figure 28. Actual coal consumed versus monthly forecast estimate, Kyger Creek

Source: LEI DR 02-007 - Attachment 1 and LEI DR 02-021-Attachment 1 – Confidential.

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 comply with the state-specific

[90] LEI-DR-02-007.

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."*[91] 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.[92]

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, similar to the RFP process, documentation should be prepared to explain the rationale for the decision.[93] LEI finds that the practice of documenting all solicitation processes and outcomes is prudent.

If there are immediate and unavoidable circumstances requiring emergency procurement, *"the abovementioned formal approaches may be waived whenever the fuel or reagents must be purchased, or transportation services must be acquired."*[94] 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."*[95] LEI recognizes the need for an emergency procurement process and deems it reasonable to implement such, 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 to help quickly locate commodity or service providers who can fill in any supply or transportation gaps.

During the audit period, AES Ohio confirmed there were no RFP solicitations issued for coal supplies.[96]

6.1.3.5 Coal supply sources

6.1.3.5.1 Supplier diversity

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[91] Request for proposal. LEI-DR-02-001 – Attachment – 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[92] Ibid.

[93] Request for proposal. LEI-DR-02-001 – Attachment – 1. American Electric Power Regulated Fuel Procurement Policy and Procedures. May 2018.

[94] Emergency procurement. LEI-DR-02-001 – Attachment – 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[95] Ibid.

[96] LEI-DR-02-004.

Based on OVEC's Coal Procurement Strategy provided in LEI-DR-02-011, OVEC states that their strategy of diversifying coal providers promotes innovation, reduces supply chain risk, and drives competition. OVEC's stated priority is to [redacted].[97]

During the audit period, Clifty Creek was served by variety of coal suppliers sourcing from the [redacted] The table below shows a list of coal suppliers/sellers for Clifty Creek, the amount of coal procured, and the average unit price (see Figure 29). As mentioned before, OVEC did not execute new coal contracts in 2020. The coal contract with [redacted].

Figure 29. Coal procured for Clifty Creek Station, weighted average contract price

[redacted]

Sources: LEI DR 02-006 Attachments 2 – Confidential and LEI DR 02-005 Attachment 3 – Confidential.

During the audit period, the majority of the coal procured for Kyger Creek was mainly [redacted] Figure 30 below displays the list of suppliers for Kyger Creek, the volume of coal procured, and the average unit price. OVEC aims to maintain a seasonal inventory [redacted] days of supply at Kyger Creek.[98]

[97] LEI DR 02-011 – Attachment 1 – CONFIDENTIAL: Coal Procurement Strategy: Procurement Targets, Inventory Targets and Supplier Diversity.

[98] LEI DR 02-011 – Attachment 1 – CONFIDENTIAL: Coal Procurement Strategy: Procurement Targets, Inventory Targets and Supplier Diversity.

Figure 30. Coal procured for Kyger Creek Station, weighted average contract price

[redacted] Generally, bituminous coals have heating values of 10,500 to 14,000 Btu/lb.
Sources: LEI DR 02-006 Attachments 1 – Confidential and LEI DR 02-005 Attachment 2 – Confidential.

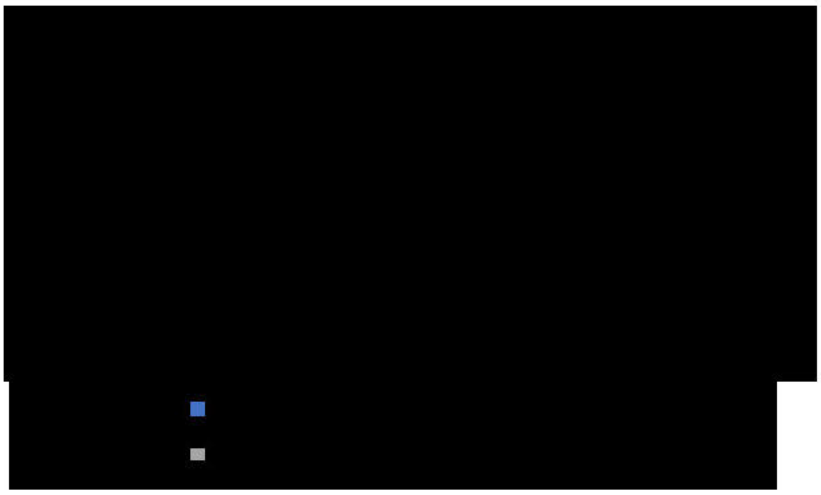
6.1.3.6 Coal spot price comparison

To assess the reasonableness of coal purchase prices during the audit period, based on the coal contracts provided by AES Ohio, LEI compared the weighted average coal supply prices in 2020 for Clifty Creek and Kyger Creek against the spot prices from S&P Global Market Intelligence (formerly SNL) Physical Market Survey data, which Energy Information Administration ("EIA") also relies on as a primary source for coal commodity spot prices (see Figure 31 and Figure 32).

Figure 31. Weighted average coal contract price for Clifty Creek plant versus S&P Physical Market Survey price

Sources: LEI DR 02-006 Attachments 2 – Confidential and third-party data provider.
Note: For Clifty Creek, the SNL Physical Market Survey price is the annual average of "Illinois Basin 11,000, 5.00 Barge."

Figure 32. Weighted average coal contract price for Kyger Creek plant versus S&P Physical Market Survey price



Sources: LEI DR 02-006 Attachments 1 – Confidential and third-party data provider.
Note: For Kyger Creek, the SNL Physical Market Survey price is the annual average of "Upper Ohio River 12,500, 6.00 Barge."

LEI found that for the Clifty Creek plant, the coal purchase prices in 2020 were significantly higher [redacted] than the spot prices from SNL. The high average price is mainly attributable to the expensive coal purchased from [redacted] of the total supply in 2020.

Coal prices for Kyger Creek plant were also higher [redacted] than the S&P Physical Markets Survey prices. [redacted] of the coal consumed by Kyger Creek. While the contract prices between [redacted] and OVEC might have been a good deal when the contract was secured, it is now above current market price.

6.1.3.6.1 Interruption or loss of supply

OVEC's "Communication of Event" emergency strategy pertains to [redacted] OVEC has a very clear flow chart that covers what to report, and to whom, in the event of a loss of supply, in order to minimize losses and maintain regular operations (see Figure 33).

Figure 33. Communication of event process

Source LEI DR 02-11 – Attachment 1 – CONFIDENTIAL: Coal Procurement Strategy: Procurement Targets, Inventory Targets and Supplier Diversity.

6.1.3.7 Hedging policy

The regulated FP states the regulated FP organization may enter into fuel hedges to support 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."*[99]

[99] Hedging policy. LEI DR 02-001 – Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

Currently, the regulated FP group is not engaged in any financial fuel hedge transactions, citing the risk of losses and associated costs. But FP has not dismissed the option of evaluating hedging opportunities that may be settled financially. The implementation of specific operating company hedging programs would be subject to the appropriate regulatory approvals and cost recovery mechanisms.[100]

6.1.3.8 Coal and reagent quality specifications and compliance

AEPSC'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 plants.[101] These specifications and sources are utilized by the regulated FP organization to evaluate the coal offers from suppliers. "[redacted]"[102] 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 AEPSC's GET Engineering FGD Systems and Chemical Engineering*."[103] Factors such as performance guarantees, profitability, service quality, and 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 AEPSC 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 OVEC.[104] 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.

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[100] Ibid.

[101] Coal and reagent quality specifications and compliance. LEI DR 02-001 – Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[102] Ibid.

[103] Ibid.

[104] "Contract administration." LEI DR 02-001 – Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

The support services from contract administration include the following:[105]

- *"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

For OVEC's operations, AEPSC'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 and system requirements.[106] The Coal Transportation, Logistics and Marketing group is responsible for the transportation of coal and other bulk commodities, logistics, and railcar leasing for OVEC'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 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.[107]

As discussed in 6.1.3.2, the 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."* [108] The

[105] "Contract administration." LEI DR 02-001 – Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[106] "Enforcement of agreements." LEI DR 02-001 – Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[107] "Organizational structure of regulated FP." LEI DR 02-001 – Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

[108] "Regulated FP considerations." LEI DR 02-001 – Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

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.*"[109]

All the coal used by the Clifty Creek plant is delivered on the Ohio River, and all via barge transportation services provided by [redacted].[110]

All the coal used by the Kyger Creek plant is also delivered via barge on the Ohio River, but the service provider is [redacted]).[111]

The transportation service cost represents the shipping cost per ton of coal from various shipping locations along navigable waterways (see Figure 34).

LEI compared OVEC's transportation costs for the Clifty Creek and Kyger Creek Stations to the 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 of Northern Appalachian coal to Ohio via barge in 2020 (see Figure 35). For the Clifty Creek Plant, the comparison was to average coal transportation costs for Illinois Basin coal in 2020.[112] Figure 35 and Figure 36 show the costs for Kyger Creek and Clifty Creek compared to EIA transportation costs. In 2020, the transportation costs incurred by both plants were higher than the EIA preliminary data but costs improved in 2020, falling to levels closer to EIA averages. Overall, OVEC was able to secure competitive transportation costs to ship coal via barge to the two plants.

[109] Ibid.

[110] LEI-DR-02-008.

[111] Ibid.

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

Figure 34. Coal transportation contracts

[redacted]

Notes:
1. Unit price via Ohio River [redacted] depending on the coal loading points.
2. Unit price via Ohio River [redacted] depending on the coal loading points.
Source: LEI DR 02-018 - Attachment 1 – Confidential and LEI DR 02-018 - Attachment 2 – Confidential.

Figure 35. Kyger Creek plant coal transportation cost compared to EIA

Source: EIA data (Average Annual Coal Transportation Costs from Coal Basin to State by Waterway / 2020 data is preliminary); LEI DR 02-16 - Attachment 1 – Confidential

Figure 36. Clifty Creek plant coal transportation cost compared to EIA

Source: EIA data (Average Annual Coal Transportation Costs from Coal Basin to State by Waterway / 2020 data is preliminary); LEI DR 02-16 - Attachment 2 – Confidential

6.1.3.11 Additional costs

In addition to coal commodity and transportation, costs are incurred to procure and manage coal inventory for Kyger Creek and Clifty Creek. 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, limestone, and hydrated lime.[113] During the audit period, reagent costs were somewhat higher than in previous years (see Figure 37).

Figure 37. OVEC reagent costs

Source: LEI DR 02-009 - Attachment 1 – CONFIDENTIAL.

6.1.4 Recommendations

Coal contract terms seem reasonable in terms of compliance with the coal procurement target strategy. Having long- and short-term contracts in place allowed for some volume flexibility. LEI believes the overall coal contracts reflect market awareness and prudency. While there were no formal internal audits conducted of the fuel procurement area, OVEC Management (including the COO, Environmental, Safety & Health Director, Treasurer, Plant Managers, and other OVEC management from the plant and the corporate office) holds a monthly coal strategy conference call with AEP Fuel Procurement.[114] These calls include discussions of procurement, inventory levels, planned unit outages, coal market, transportation, reagents and contract delivery or quality issues. The information discussed serves as a means of optimizing decisions and validating actions of procurement, inventory management and shipment/delivery.

LEI makes the following recommendations:

[113] LEI-DR-02-017.

[114] LEI-DR-02-013.

- As illustrated in Figure 27 and Figure 28, the coal burn forecasts were consistently higher than the actual burns. LEI recommends that AES Ohio, in its role on the OVEC Operating Committee, examine the process that creates these forecasts and conduct the forecast more frequently to reduce the discrepancies between the actual and estimated coal burns.
- The coal contract prices for Clifty Creek plant were higher than market prices in 2020. However, the [redacted], which is a very large contract and the one which is most out of line with the current market, is set to expire at the end of 2021. LEI assumes that future contracts will reflect the lower prices currently prevailing in the market.

6.2 Coal inventory management

6.2.1 Scope and background

6.2.1.1 Scope

The regulated FP organization within AEPSC is responsible for coal inventory policy and management of the coal serving the Kyger Creek and Clifty Creek power stations. OVEC's procurement practices and outcomes related to coal inventories impact AES Ohio's ratepayers, and are therefore 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.

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 inventories provide protection against coal supplier default or delays in coal transportation. According to the regulated FP, its job is to ensure *"the availability of an adequate, reliable supply of fuel (and reagents) at the lowest reasonable delivered cost for the generation of electricity."*[115] An appropriate quantity of coal is supposed to be maintained at a plant.

6.2.2 Evaluative criteria

LEI focused its audit of coal inventory management on answering the following questions:

[115] Proper inventory levels. LEI DR 02-001 – Attachment 1. American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

1. Does the coal inventory policy 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?

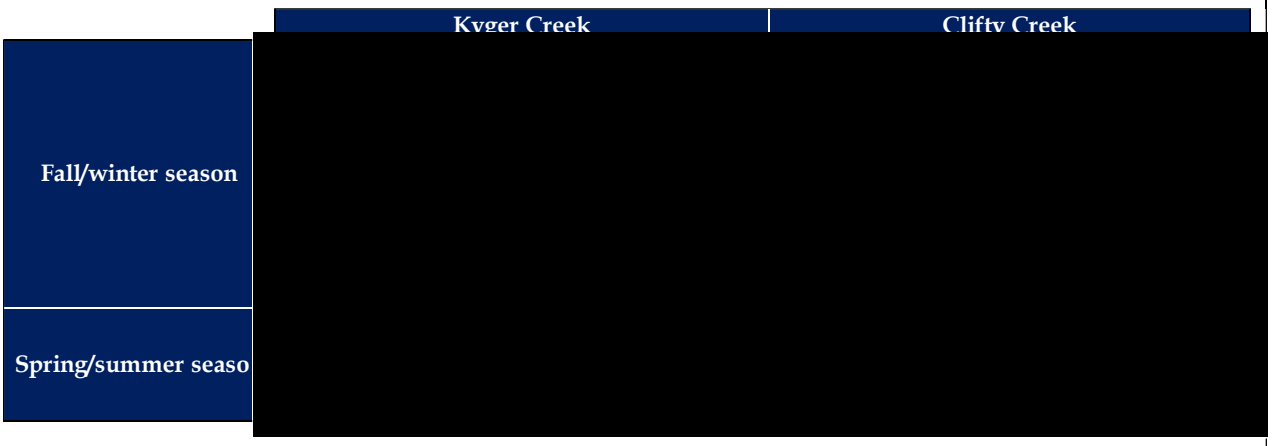
6.2.3 Findings and conclusions

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.[116]

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 38).

Figure 38. Coal inventory targets



Source: LEI DR 02-11 – Attachment 1 – CONFIDENTIAL: Coal Procurement Strategy: Procurement Targets, Inventory Targets and Supplier Diversity.

The full-load requirement depends on the units' summer and winter seasonal capability. Spring/summer capability is usually lower than winter by a few MW because of higher river temperatures (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 the spring/summer level.

[116]LEI DR 02-001 – Attachment 1. "Proper inventory levels." American Electric Power Regulated Fuel Procurement Policy and Procedures May 2018.

6.2.3.2 Inventory control

Coal inventory levels at Clifty Creek averaged about [redacted] in 2020 (see Figure 39). The 2020 inventory levels remained significantly above OVEC's recommended seasonal inventory of [redacted] days for the fall and winter seasons, and [redacted] for the spring and summer seasons.[117] Inventory increased at Clifty Creek during the spring, when generation was low. The COVID-19 induced low prices and the low generation from the plant may have resulted in inaccurate forecasts of coal burns.

Figure 39. Clifty Creek coal inventory level

[redacted]

Source: LEI DR 02-019 - Attachment 1 – Confidential and LEI DR 02-011 - Attachment 1 – Confidential.

Figure 40. Clifty Creek generation and capacity factor

[redacted]

Source: LEI DR 05-005 – Attachment 2 – CONFIDENTIAL.

[117] LEI DR 02-11 – Attachment 1 – CONFIDENTIAL: Coal Procurement Strategy: Procurement Targets, Inventory Targets and Supplier Diversity

Kyger Creek's inventory level averaged about [redacted] in 2020 (see Figure 41). Inventory levels were significantly higher than OVEC's recommended seasonal inventory of [redacted] for the fall and winter seasons, and [redacted] for the spring and summer seasons. Inventory also increased at Kyger Creek during the months with the lowest net generation and capacity factor (see Figure 42). Similarly to Clifty Creek, this may have resulted in a less accurate coal burn forecast, thus driving inventories significantly above the target in the following months.

Figure 41. Kyger Creek coal inventory level

Source: LEI DR 02-019 - Attachment 1 - Confidential and LEI DR 02-011 - Attachment 1 – Confidential.

Figure 42. Kyger Creek generation and capacity factor

Source: LEI DR 05-005 – Attachment 2 – CONFIDENTIAL.

6.2.4 Recommendations

At both power plants, coal inventory levels in 2020 were substantially higher than the inventory targets. LEI makes the following recommendations:

- To the extent current coal contracts might not feature flexibility for coal deliveries (i.e., requirements contracts), LEI recommends that AES Ohio, in its role on the Operating Committee encourage OVEC to consider requirements contracts in the future. This will help keep inventories from exceeding targets.
- AES Ohio, in its role on the Operating Committee, should encourage OVEC to procure slightly less through long-term contracts, and procure some coal through short-term contracts as needed. This will help keep inventories from exceeding targets.
-
- AES Ohio, in its role on the Operating Committee, should encourage OVEC to 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 and solids regulations;
- organizational structure and qualifications of personnel;
- current status of OVEC's environmental controls;
- 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, participated in an on-line virtual plant site visit with OVEC personnel, and conducted additional research.

7.1.2 Background on emissions regulation

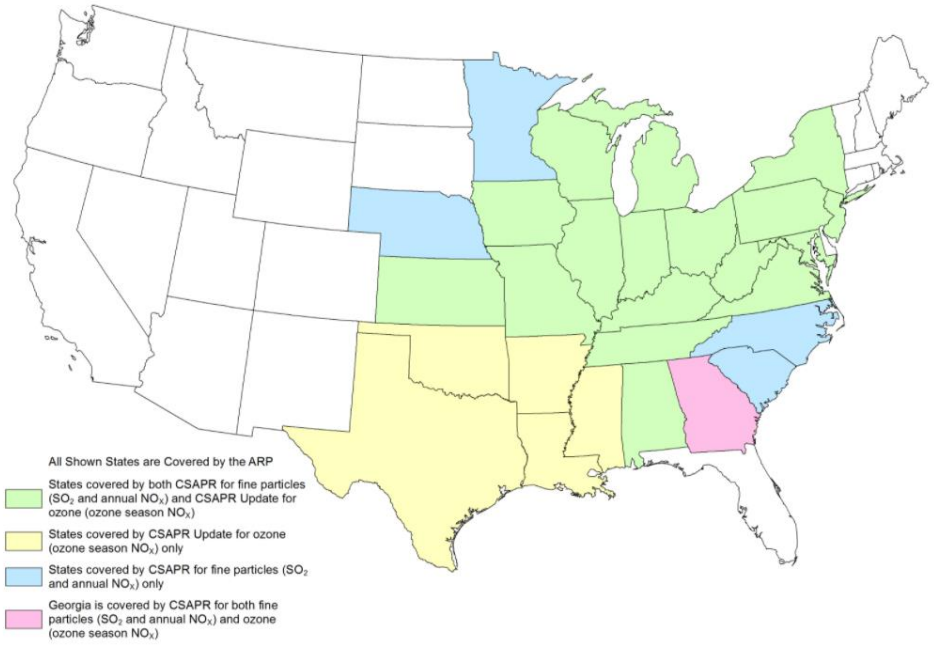
7.1.2.1 Air regulations

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 NO_x 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 NO_x; 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"). On May 1, 2017, the CSAPR Update ozone season NO_x program replaced the original CSAPR ozone season NO_x program. On March 15, 2021, the EPA finalized the Revised CSAPR Update that would reduce NO_x emissions from

power plants in the eastern United States, including Ohio by 17,000 tons.[118] Figure 43 below illustrates the CSAPR footprint across the United States.

Figure 43. States covered by CSAPR



Source: EPA, Clean Air Markets.

7.1.2.2 Solids regulations

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 2020 annual report "*[t]he US EPA elected to regulate CCR as a non-hazardous solid 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*."[119]

7.1.2.3 Water regulations

OVEC plants must comply with EPA's Effluent Limitations Guidelines ("ELG") limiting wastewater discharge (bottom ash transport wastewater and wastewater from the scrubbing process). EPA published the final ELG revisions in the Federal Register on October 13, 2020.[120] In

[118] "Revised Cross-State Air Pollution Rule Update". EPA. Web. Accessed on November 01, 2021. < https://www.epa.gov/csapr/revised-cross-state-air-pollution-rule-update>

[119] OVEC. *Annual Report 2020*. p. 33. <https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf>

[120] LEI-DR-04-008.

light of the rules, OVEC will have until December 31, 2025 to determine the technology it will use to comply with the rules, and to have it in place. This is discussed in detail in Section 7.3.3.

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 implemented 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.[121]

The ESH Department consists of 13 staff (see Figure 44), and their duties and responsibilities include:[122]

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

- *"Staying current with all new legal precedence and technology developments relating to environmental compliance with Company operations;" Staying current with all new legal*

[121] LEI-DR-04-001.

[122] Ibid.

precedence and technology developments relating to environmental compliance with Company operations;"

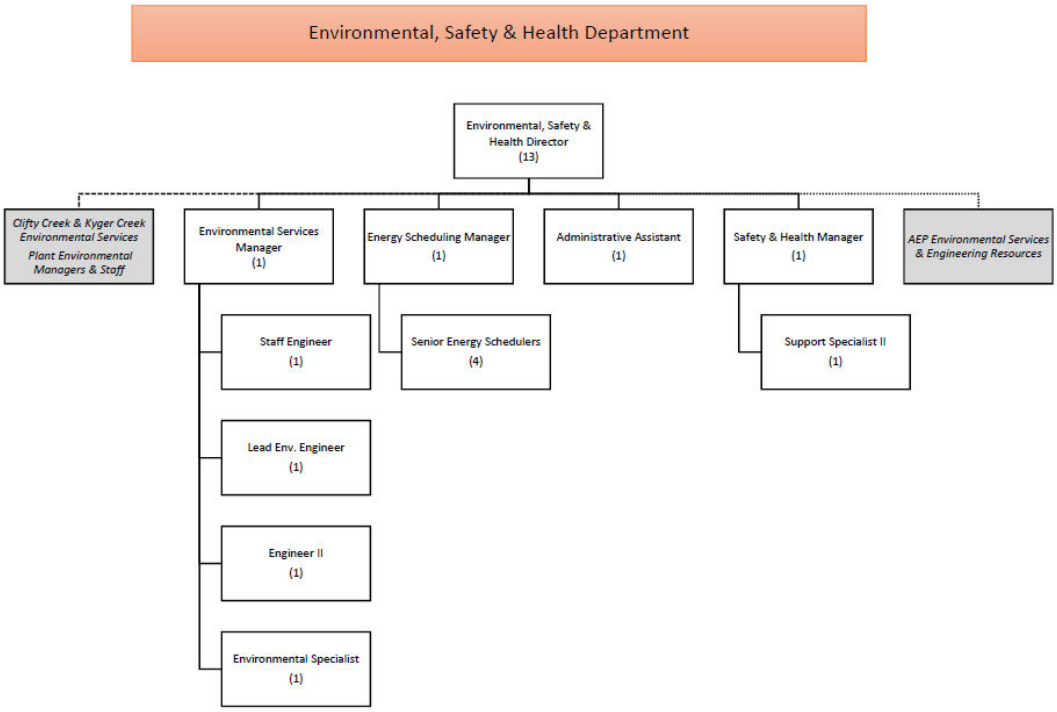
- *"Securing and renewing all federal and state air, water, and solid waste permits required to meet applicable compliance obligations at all company facilities;" Securing and renewing all federal and state air, water, and solid waste permits required to meet applicable compliance obligations at all 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 44. OVEC-IKEC ESH Department Organization Chart



Source: LEI DR 01-008 – Attachment 1; LEI DR 04-001 – Attachment 1.

7.3.2 Current environmental control status of OVEC plants

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 to comply with environmental laws and regulations at the federal, state, and local levels. The current installed environmental controls and monitors for both plants are:[123]

- **Overfire air system ("OFA"):** to meet the emission requirements for NO_x, 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 Amendments ("CAAA"). The overfire air system effectively reduces NO_x emissions by 50%. The OFAs for each plant will last the life of the plant, with ongoing maintenance; for example, the burners are inspected, repaired, and replaced on an ongoing basis.[124]

- **Selective catalytic recovery ("SCR") system**: SCR equipment was installed in 2002 and 2003 to meet additional NO_x reduction requirements applicable to the ozone seasonal cap and trade program under the US EPA's NO_x State Implementation Plan Call Rule. SCRs convert NO_x in the furnace exhaust gas into N_2, H_2O and CO_2. Each unit in OVEC has its own SCR except for Clifty Creek Unit 6 which is not self-scheduled, but offered based on economics during summer ozone season (see Figure 45 and Figure 46). According to a 2011 Louisville Gas and Electric Company and Kentucky Public Service Commission long-term PPA, "[s]ince the current NO_x regulations allow "bubbling" of the emissions from both Clifty and Kyger and since OVEC chose to design the reactors for a NO_x removal efficiency of 90%, sufficient margin existed to allow one unit to remain uncontrolled."[125] The SCR has the added benefit of converting trace amounts of mercury (H_g) in to a form which can be removed by scrubbers (discussed below).[126] However, SCRs also create SO_3, which cannot be removed by scrubbers (again, discussed below). To address this, the plants use dry sorbent injection equipment (which relies on injection of trona or hydrated lime) to capture the SO_3 The SCRs can last the life of the OVEC plant (until at least 2040) based on a maintenance regime and would not need new capital expenditure.[127]

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[123] LEI-DR-04-007; LEI DR 04-007 – Attachment 1; Oral presentation from OVEC staff during the virtual plant site visit on November 17, 2021.

[124] Oral presentation from OVEC staff during the virtual plant site visit on November 17, 2021.

[125] Kentucky Public Service Commission. "Emission Control System". Long-term Purchase Contract - Case No. 2011-00099. July 2011. p. 45. < https://psc.ky.gov/pscscf/2011%20cases/2011-00099/20110711_LGEs%20Response%20to%20Commission%20Staffs%20Supplemental%20Response%20Question%20No%201.pdf>

[126] Oral presentation from OVEC staff during the virtual plant site visit on November 17, 2021.

[127] Ibid.

- **Electrostatic precipitator:** In the 1970s, the electrostatic precipitators were installed at all 11 OVEC-IKEC units to comply with the 1970 Clean Air Act ("CAA"). They remove small particles of ash and SO_3, by using reduced velocity and an electric charge. The electrostatic precipitators collect over 90% of the fly ash produced in the combustion process. They are inspected and maintained during plant outages and no new capital is needed for them to last the life of the plant.[128] At Clifty Creek, the fly ash is disposed of in a dry state and can be sold for re-use or deposited on site. At Kyger Creek, the fly ash is currently mixed with water and the resulting slurry is deposited into a settling pond, but OVEC is in the process of converting to dry fly ash removal to meet EPA EFL guidelines (equipment is expected to be online in 2023).[129]

- **Flue gas desulfurization ("FGD") systems:** FGD systems were completed in 2012 for Kyger Creek and 2013 for Clifty Creek. FGD systems are designed to remove SO_2. At Clifty Creek and Kyger Creek, the equipment chose for the main scrubbing task is the jet bubbling reactor ("JBR") design and proper operation brings co-benefits of lower particulate matter and lower mercury emissions, which help comply with EPA's MATS rule without the need for additional pollution control equipment. JBR 12 at Kyger Creek scrubs flue gas from generation Units 1 and 2, and JBR 35 scrubs Units 3, 4, and 5. Clifty Creek's JBR 13 scrubs Units 1, 2, and 3, and JBR 46 scrubs Units 4, 5, and 6.

    - **JBR**: The JBR performs the actual scrubbing and reduces SO_2 emissions by up to 98% at the plants; and

    - **Related equipment**: FGD systems at each plant included two JBRs, a new stack with two flues (one for each JBR), a FGD wastewater treatment plant ("WWTP") to treat the residual wastewater created by the JBRs, new landfills, a limestone barge unloader, limestone preparation and storage equipment, gypsum dewatering, and a trona dry sorbent injection system for SO_3 mitigation.

- **Continuous emissions monitoring system ("CEMS"):** Primary and redundant backup monitoring systems were installed on each new flue when the scrubbers were placed into service. CEMS continuously monitors the CO_2, NO_x, SO_2, particulate matter ("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 NO_x, CO_2, and SO_2 flow monitors were installed to meet EPA reporting requirements. Mercury and PM monitoring systems were installed for MATS compliance. OVEC staff manage air pollution control in real time to make sure the emissions do not exceed the US EPA limit. The plants are in the process of replacing/updating the CEMS monitors.

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[128] Ibid.

[129] Ibid.

Figure 45. Clifty Creek air pollution control process

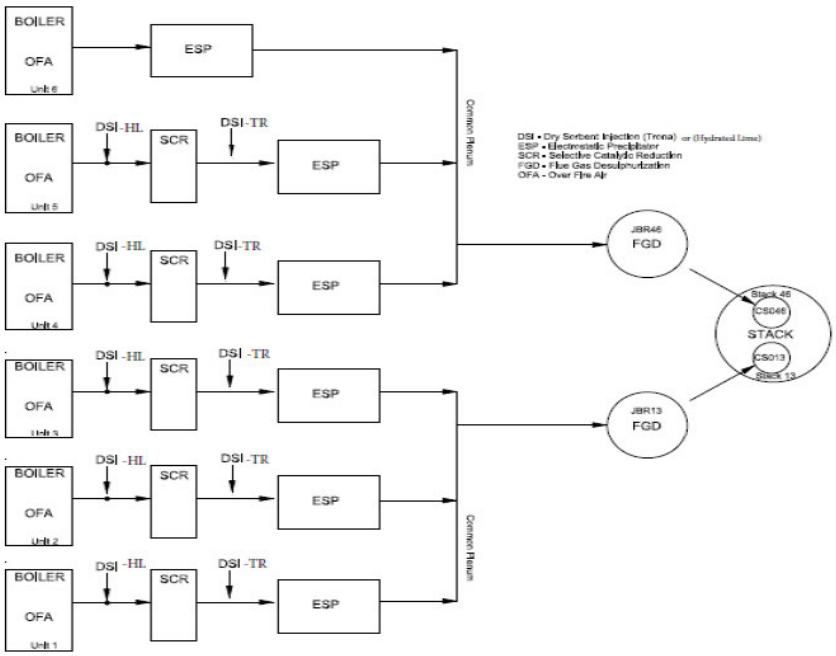
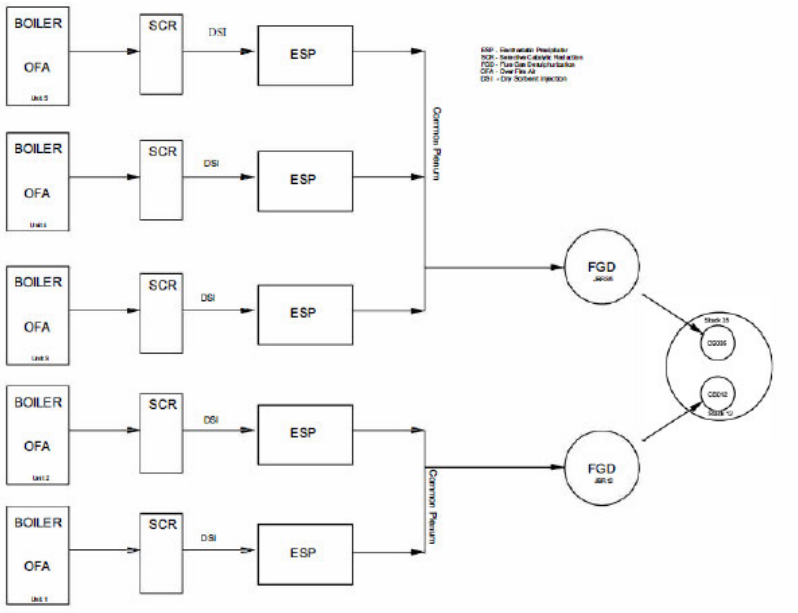


Figure 46. Kyger Creek air pollution control process



Source: LEI DR 04-007 – Attachment 1; Oral presentation from OVEC staff during the virtual plant site visit on November 17, 2021.

As noted above, OVEC reported that through proper maintenance the pollution control equipment it can last for many decades.[130] Figure 47 lists the major equipment at Kyger Creek and Clifty Creek facilities installed since the late 1970s to comply with environmental regulations.

Figure 47. Kyger Creek and Clifty Creek environmental compliance equipment

Project	Purpose	Installation Date(s)
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 04-010 – Attachment 1.

7.3.3 OVEC's environmental compliance

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

With the adoption of EPA's CSAPR Update Rule, in 2019, OVEC managed its operations to comply with the more stringent NO_x constraints effective during the ozone season. The final rule revising the CSAPR Update was signed on March 15, 2021 and OVEC does not expect it to impact the near-term compliance strategy or materially change future operations.[131]

OVEC has been using the Effluent Limitations Guidelines ("ELG") draft rules published in November 2019 as the basis for planning its compliance with rules limiting wastewater discharge (bottom ash transport wastewater and FGD wastewater). EPA published the final ELG revisions in the Federal Register on October 13, 2020.[132] In light of the rules, OVEC will have until December 31, 2025, to modify how it manages both bottom ash transport wastewater and FGD wastewater. OVEC has engaged a third-party engineering firm to assist in developing an overall holistic compliance strategy based on terms of the final ELG rules, and other applicable federal and state regulations that may impact timelines for modifying treatment systems to meet new ELG requirements at both plants. The dry fly ash project for Kyger Creek discussed previously is under

[130] Oral presentation from OVEC staff during the virtual plant site visit on November 17, 2021.

[131] OVEC. *Annual Report 2020*. P. 32. <https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf>

[132] LEI-DR-04-008.

construction and set to be completed in 2023, to comply with ELG rules. Both plants are now undergoing other modifications to comply with the rules.[133]

To comply with EPA Clean Water Act Section 316 (b) for cooling water intake structures, both Kyger Creek and Clifty Creek are participating in an Electric Power Research Institute ("EPRI") collaboration project. OVEC was obligated to conduct a two-year study of EPA Clean Water Act Section 316 (b) requirements and associated control technology recommendations, which they completed, and submitted to the Ohio state regulatory agency in 2018.[134] The report included a summary of the preliminary cost estimates for the technologies evaluated, conclusions and other information required under Section 122.21(r) of the 316(b) Rule. OVEC still expects to prepare a comprehensive and detailed cost estimate following consultation with Indiana Department of Environmental Management ("IDEM") and Ohio EPA following their site-specific determination of what constitutes Best Available Technology ("BAT") for each plant, consistent with Section 125.98(f) of the 316(b) Rule. That determination needs to be made before OVEC takes the next step in developing detailed costs and finalizing schedules, and neither state regulatory agency did so in 2020.

IDEM has stated they will be conducting their evaluation as part of the next National Pollution Discharge Elimination System ("NPDES") permit renewal for the Clifty Creek Station. The current permit is effective through May 1, 2022, and OVEC expects IDEM's evaluation to address the Station's future 316(b) obligations to take place in late 2021 or early 2022. Ohio EPA is expected to make a similar determination for Kyger Creek Station in either late 2021 or early 2022 as well.[135]

To comply with EPA CCR, OVEC noted in its most recent annual report that all compliance is complete: "*The Companies have completed all compliance obligations associated with the rule to date…. currently, approximately 65 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*."[136]

7.3.3.2 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. This creates spent slurry, as known as gypsum. The absorber removes the dewatered gypsum which becomes a useful byproduct and source of revenue for OVEC.

As of 2018, 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

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[133] Ibid, and virtual site visit November 17, 2021.

[134] OVEC. Annual Report 2017. P. 29. <https://www.ovec.com/FinancialStatements/2017-ConsolidatedFinancials.pdf>

[135] LEI-DR-04-009.

[136] OVEC. *Annual Report 2020*. P. 34. <https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf>

wallboard manufacturer.[137] As of 2019, OVEC sold nearly all of the gypsum produced at each plant into the wallboard market.[138] For both plants, OVEC evaluated options for installing barge loading facilities on-site which could provide additional support for fly ash and boiler slag marketing.[139] The revenues from the sales of gypsum are used to offset the fuel and reagent 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.[140] The revenue from the ash sales is expected to reduce total fuel and reagent costs. Modifications of the wastewater treatment systems began in 2021 as noted above.[141, 142]

7.3.3.3 OVEC's compliance strategy

OVEC's overall compliance strategy involves installing equipment and maintaining a bank of emissions allowances. The OVEC 2020 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 NO_x allowances, or ozone season allowances in 2020 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 2021 and beyond for compliance with the CSAPR and CSAPR Update rules."*[143]

7.3.4 Emissions allowances and trading

7.3.4.1 OVEC's designated staff

The Environmental Safety & Health Director is the Designated Representative (or Authorized Account Representative ("AAR")) at OVEC and is responsible for overall emissions allowance inventory management and associated compliance activities, which include the allowance bank management and surrender of allowances via US EPA's Clean Air Markets Division ("CAMD")

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[137] OVEC. *Annual Report 2018*. P. 3. <https://www.ovec.com/FinancialStatements/AnnualReport-2018-Signed.pdf>

[138] OVEC. *Annual Report 2019*. p. 4. <http://www.ovec.com/FinancialStatements/AnnualReport-2019-Signed.pdf>

[139] Ibid.

[140] OVEC. *Annual Report 2020*. p. 31 <https://www.ovec.com/FinancialStatements/2020-ConsolidatedFinancials.pdf>

[141] LEI-DR-04-008.

[142] Oral presentation from OVEC staff during the virtual plant site visit on November 17, 2021.

[143] Ibid.

Business System website.[144] Further, the AAR has an Alternate Authorized Account Representative ("AAAR"), who is the Environmental Services Manager based at OVEC's corporate office in Piketon, Ohio, 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 NO_x and SO_2 emissions from the electric utility sector."*[145] 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 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.[146]

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. Under the federal Acid Rain or CSAPR regulations, OVEC surrendered the allowances allocated to the units under those respective compliance programs.[147]

As for NO_x emissions control, OVEC's overall strategy is to *"operate in a manner to limit or avoid the need to purchase annual or seasonal NO_x allowances in the secondary market."*[148] Generally, OVEC has very limited need to purchase additional allowances due to the stringent environmental compliance obligations and high efficiency of plants' pollution control equipment. During the audit period, OVEC confirmed that neither seasonal nor annual NO_x allowances were purchased.[149]

7.3.4.3 OVEC's purchase of emissions allowances

As mentioned above, OVEC did not make any allowance purchases during the audit period. In the past, OVEC's purchasing process for emissions allowances was mainly through the trading services of one of its Sponsors (usually AES Ohio) to make sure the purchase is made based on fair market prices and reasonable brokerage fees at the time of the purchase.[150] For each allowance

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[144] LEI-DR-04-002.

[145] Ibid.

[146] LEI-DR-04-002; LEI-DR-04-003.

[147] LEI-DR-04-002.

[148] Ibid.

[149] Ibid.

[150] LEI-DR-04-003.

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 AAR is responsible for managing the emissions allowances purchase to meet OVEC's needs.[151]

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

OVEC's AAR and AAAR have the primary responsibility for fulfilling emission allowance management and associated compliance obligations, including banking and inventory management.[152] The general strategy for banking and inventory management is that allowances surrenders are made on a last-in, first-out basis to minimize the costs incurred and billed to sponsors.[153]

For allowances purchased by OVEC, they are valued on a weighted average basis and sponsoring companies are billed for them based on the actual monthly emissions reported by Kyger Creek and Clifty Creek.[154] However, allowances which are allocated to the plants are accounted for differently: *"Allowances directly allocated to the plants by EPA are not assigned a cost and sponsors are not billed when such allowances are surrendered."*[155]

OVEC has not purchased any allowances on the secondary market since complying with the CSAPR and Acid Rain programs.[156]

Figure 48 below shows a summary of the 2020 allowance bank totals, the weighted average cost of allowances that still have a value from prior year purchases, the number of allowances surrendered in 2020, the 2020 balance, and additional 2021 vintage allowances EPA has allocated to the units for 2020.

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[151] Ibid.

[152] LEI-DR-04-005.

[153] Ibid.

[154] LEI-DR-04-006.

[155] Ibid.

[156] Oral presentation from OVEC staff during the virtual plant site visit on November 17, 2021.

Figure 48. OVEC emissions allowance account balance as of 2020

Source: LEI DR 04-011 - Attachment 1 – Confidential.

LEI notes that, at [redacted]/ton, the 2020 year-end inventory of ozone season NO_x allowances for 2020 was worth [redacted].[157] This is the most expensive inventory of allowances—SO_2 and annual ozone inventory values are much lower, because the prices of allowances are lower. Since the EPA is providing about the same number of ozone season NO_x allowances annually, the ozone season inventory level for 2020 is probably higher than needed. Though it may be overly conservative, LEI believes the inventory management for seasonal NO_x allowances is reasonable. Management of other emissions inventories was reasonable and represent low costs to customers.

7.3.5 Evaluating, and implementing compliance options

OVEC's strategy for evaluating options for compliance and implementing these options is based on what is required to meet state and federal regulations.[158] The capital budget for environmental

[157] NO_x allowances for [redacted] = 2021 EPA provided allowance allocation or [redacted] tons multiplied by weighted average cost of allowances held in inventory or [redacted]

[158] Oral presentation from OVEC staff during the virtual plant site visit on November 17, 2021.

compliance is approved by the OVEC Board of Directors. As discussed in Section 8, there is no cap on annual capital expenditures.

7.4 Recommendations

Based on the virtual plant site visit and data request responses from AES 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 and state 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.

8 Capital expenses

8.1 Scope and background

8.1.1 Scope

Capital expenses incurred by OVEC are allocated and billed to AES Ohio through the demand charge on the OVEC bill. In turn, these are billed to AES Ohio customers in the LGR Rider and are therefore within the scope of the audit.

This chapter addresses the following topics:

- decision and budgeting procedures 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.

8.2 Evaluative criteria

LEI focused its audit on answering the following questions:

1. Were capital projects planned based on a prudent approval process?
2. Were capital projects well managed and completed within budget?

8.3 Findings and conclusions

8.3.1 Overview

According to OVEC's 2020 annual report *"[a]ll property additions and replacements are fully depreciated on the date the property is placed in service, unless the addition or replacement relates to a financed project. As the Companies' policy is to bill in accordance with the debt service schedule under the debt agreements, all financed projects are being depreciated in amounts equal to the principal payments on outstanding debt."*[159]

[159] OVEC. *Annual Report 2020*. p. 17. < https://www.ovec.com/FinancialStatements/AnnualReport-2020-Signed.pdf>

Capital expenses are billed to the Sponsoring Companies in the OVEC demand charge. The demand charge includes Component A which captures the cost of debt, deprecation, and amortization; and Component B which covers non-fuel expenses for the plants.[160]

Total capital spending in OVEC was $8.55 million.[161] This annual amount is far lower than the 2020 total of Component A ($180.4 million) and Component B ($143.3 million) in the OVEC bill. The OVEC bill includes charges from capital spending in previous years.

8.3.2 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 49 below).

Figure 49. The six-step capital budget process at OVEC

Source: LEI-DR-03-001.

The six steps involve the following activities and teams:

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

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

3) The **Budget Excellence Team Review is led by** a group of individuals with multidisciplinary backgrounds and from various locations and departments. The team reviews the quality of the project's justifications and alternatives;

[160] LEI DR 02-009 - Attachment 1.

[161] LEI DR 03-002 - Attachment 1 – Confidential.

4) The **Site Level Review** is led by a group consisting of the Plant Manager and plant Department Heads, who prioritize projects for their location and provide feedback regarding the projects and associated justifications;

5) The **Executive Management Review** is led by a team made up of the Chief Operation Officer ("COO"), Chief Financial Officer ("CFO"), Kyger Creek Plant Manager, Clifty Creek Plant Manager, Environmental, Safety & Health Director, and Electrical Operations Director. The team reviews the projects and then prioritizes them based on safety, environmental compliance, expected return, reliability risk, and capital budget targets; and

6) The **Board of Directors** ("BOD") reviews and approves capital budgets at the annual BOD meeting.

LEI believes that this capital project budget approval process provides a good foundation for capital project planning and implementing. However, it 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, OVEC should make transparent the 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.

8.3.3 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 that the Commission consider implementing such a cap. However, OVEC is not allowed to earn a return on capital projects.

8.3.4 Capital projects were generally completed within budget

LEI reviewed the budgeted and actual costs of OVEC's capital projects in 2020. 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 2020 for major projects (see Figure 50 below). One fairly minor project, replacing core switches and router at Clifty Creek, exceeded the budget by a substantial margin.

Figure 50. Budgeted and actual costs of all OVEC capital projects, 2020

Note: Red highlights represent projects with actual capital spending higher than budgeted amount.

Source: LEI DR 03-002 - Attachment 1 - Confidential.

8.3.5 Capital projects are typically for environmental and economic purposes with a payback period of around four years

LEI reviewed all [redacted] projects that had budgeted amounts greater than $500,000 and examined OVEC's project planning materials (provided in LEI DR 03-002 - Attachment 2 - Confidential) to check the prudency of capital spending. The planning materials included detailed information such as project description, cost and benefit analysis and alternatives considered (see Figure 51 below). OVEC states that projects were focused on to delivering economic benefits and environmental compliance, went through a cost-benefit analysis (with an average simple payback timeline of around 3.3 years), and OVEC compared them to alternatives in terms of practicality and cost.

Figure 51. Detailed summary of selected capital projects of OVEC

Source: LEI DR 03-002 - Attachment 2 - Confidential.

8.4 Recommendations

In general, capital projects at OVEC were completed within budget and followed a prudent evaluation process. The capital investment appears to have addressed environmental issues or improved plant economics.

However, this does not imply that the level of capital spending is justified by the revenues earned by the plants in the PJM market. Recent annual capital expenditures of about $8 million to $9 million represent a small portion of the demand charge paid by AES Ohio and other Sponsoring Companies; the overall cost to recover the investment in the plants (recovered in Component A and Component B of the demand charge) is much larger, as noted above.

9 Power plant operations

9.1 Scope and background

9.1.1 Scope

OVEC's plant operation and maintenance activities impact 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;
- power plant performance tracking; and
- emergency procedures.

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 and Kyger Creek includes five coal-fired generating units (see Figure 52). The units are all relatively old (operating since 1955 or 1956) and small, with nameplate capacity of 217.3 MW each, while new coal steam turbines tend to be about 500 MW.

Figure 52. OVEC-owned generating units, 2020

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
					Total	*1303.8*	-
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
					Total	*1086.5*	-

Source: S&P Global Market Intelligence; OVEC Website <https://www.ovec.com/Clifty.php>; <https://www.ovec.com/Kyger.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?

5. What emergency procedures are in place to deal with extreme weather or flooding? How did plant managers respond to the impacts of COVID-19 in 2020?

9.3 Findings and conclusions

9.3.1 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 213 staff members working at Kyger Creek and 241 at Clifty Creek (see Figure 53).[162] The number of employees is comparable to the average for coal plants in PJM, which is 238.[163]

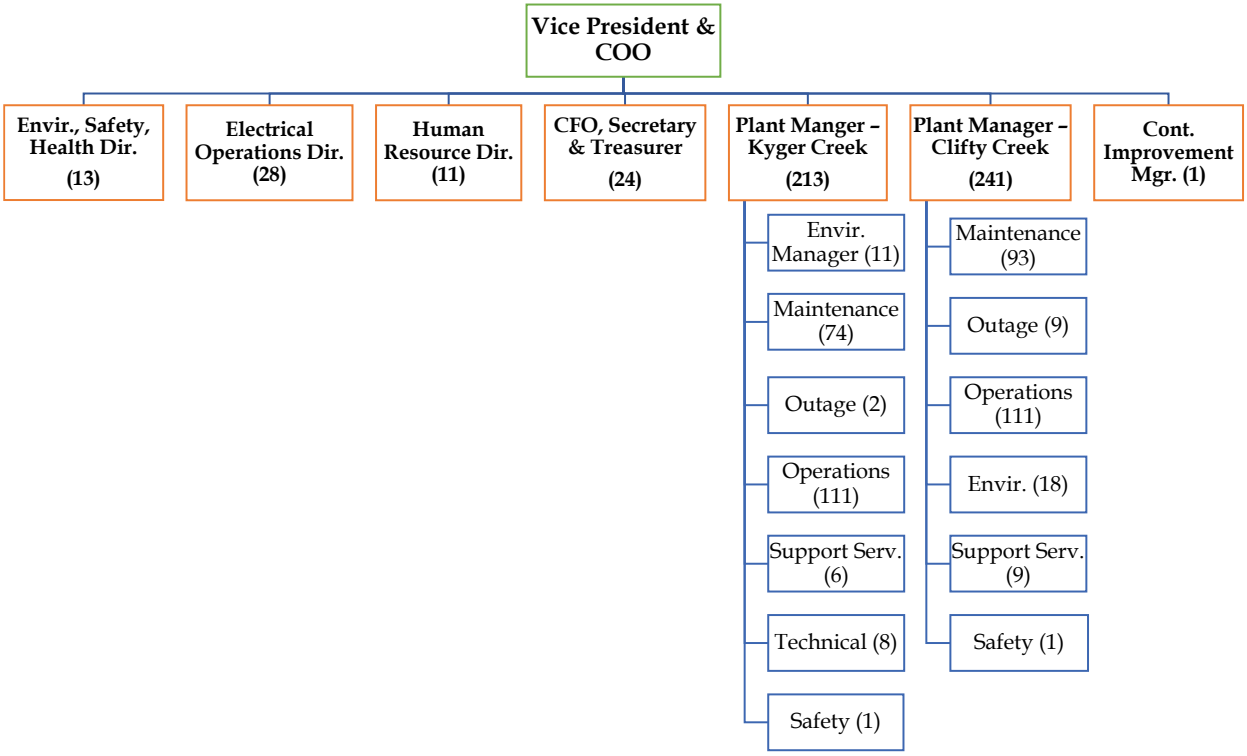
The total number of staff at both plants declined from 2019 to 2020. AES reported that the differences in staffing levels between 2019 and 2020 at both plants were primarily driven by attrition due to employee retirements. When that takes place, each plant evaluates those vacancies and takes a disciplined approach to determine whether those positions can be consolidated, contracted to a third-party strategic partner more effectively, and/or if that position needs to be filled with an external hire. In general, as operations positions become vacant, the plants have been hiring replacement employees to backfill those vacant positions. Other positions from all other departments that become vacant are generally being either consolidated or are being subcontracted out to strategic partners where warranted.[164]

[162] LEI - DR - 05-001 - Attachment 1; LEI - DR - 05-001 - Attachment 2.

[163] S&P Global Market Intelligence.

[164] LEI- DR- 05-011.

Figure 53. OVEC – IKEC plant management staffing, 2020



Source: LEI - DR - 05-001 - Attachment 1; LEI - DR - 05-001 - Attachment 2.

Note: Actual totals of plant management staff are shown for Kyger Creek (213) and Clifty Creek (241).

LEI examined the operations and maintenance ("O&M") costs (labor plus non-labor) for the two plants. As shown in Figure 54, for the period of 2018-2020, the Clifty Creek and Kyger Creek plants cost an average of [redacted] million (or [redacted]/kW-year) and $[redacted] million per year (or [redacted]/kW-year) for O&M, respectively. Around [redacted] 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 based on LEI's empirical knowledge but is not unreasonable given the considerable amount of spending on materials that might be required in the event of planned or unplanned outages.

Figure 54. OVEC – Labor and non-labor O&M costs for Clifty Creek and Kyger Creek, 2018-2020

Source: LEI DR 05-007 - Attachment 1 – Confidential.

9.3.2 Plant maintenance processes

Regular planned maintenance is important to ensure reliability of supply from the generating fleet. 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.[165] Major outage projects (including but not limited to SCR catalyst replacement, air heater basket major replacement, major boiler tube replacements, ash hopper rebuilds, booster fan rebuilds, JBR repairs, and turbine inspections) require large crews for a specific duration and are therefore contracted. Craft labor is contracted for scaffolding, insulation, and vacuuming needs. Plant 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).[166]

9.3.3 Planned outage process is well designed

OVEC uses a comprehensive handbook which clearly delineates roles and responsibilities related to planned outages.[167] Outages at OVEC's plants are planned and executed by the Outage Management Team, which involves the following key members:[168]

- **Outage Manager:** assigned by the Plant Manager, or delegate. The Manager is responsible for the maintenance of the opportunity outage pool lists (when unanticipated changes on

[165] LEI-DR-05-003.

[166] Ibid.

[167] LEI DR 05-002 - Attachment 1.

[168] Ibid.

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. The Planner 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;

- **Operations Production Superintendent/Gate Keeper:** represents the Operations organization and assists members of the Outage Management Team;

- **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; and

- **Outage Coordinator:** responsible for coordinating assigned outage activities such as contracted cleaning services, or large-scale projects requiring oversight.

OVEC's handbook outlines a standard planned outage process 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 55).[169]

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,

[169] Ibid.

budgeted, and ordered. On an annual basis the following year's budget is provisionally approved by top level management.

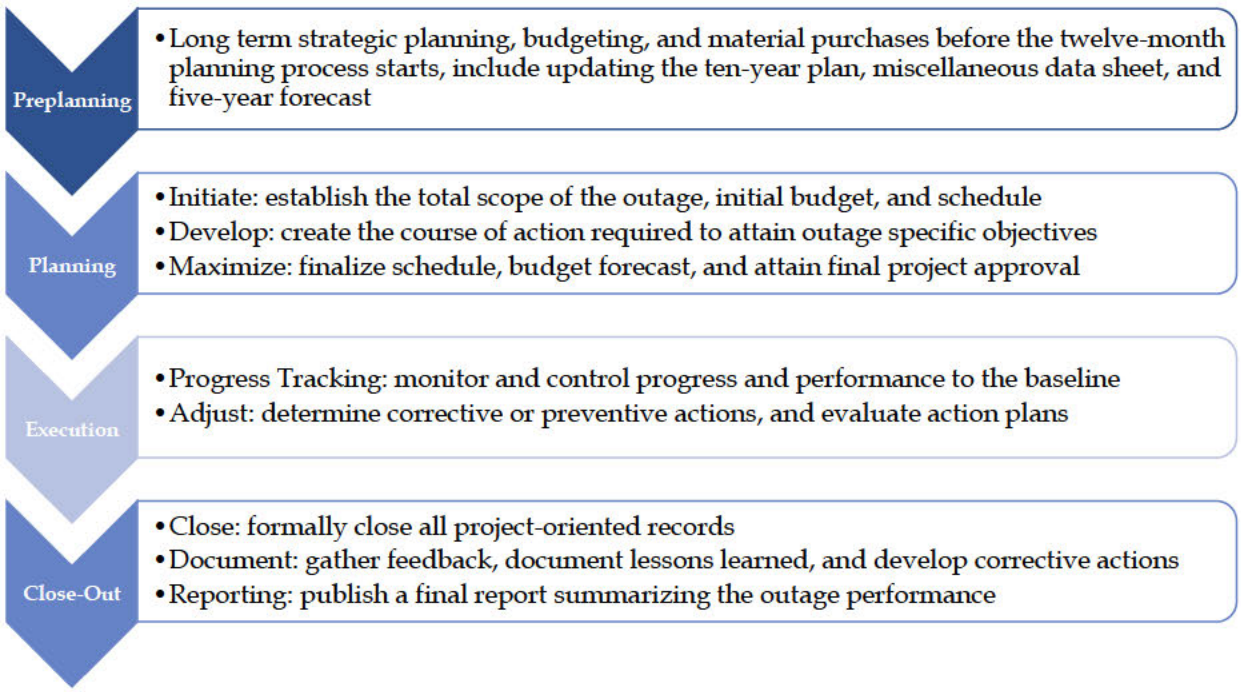
The **Planning** process develops the annual project plan and documents that will be used to carry out the outage. The Planning step is made up of three phases: *Initiate*, *Develop*, and *Maximize.* These phases encompass a twelve-month (48-week) timeline, and there is overlap among them.

- *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.

- *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.

- *maximize* phase finalizes the course of action required to attain specific outage objectives. This phase includes publishing the level 3 schedule (a detailed schedule with the critical path identified), 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 55. OVEC's outage planning process



Source: LEI DR 05-002 - Attachment 1.

The **Execution** step consists of the processes 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.

- *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.

- *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.

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

- *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.

- *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.

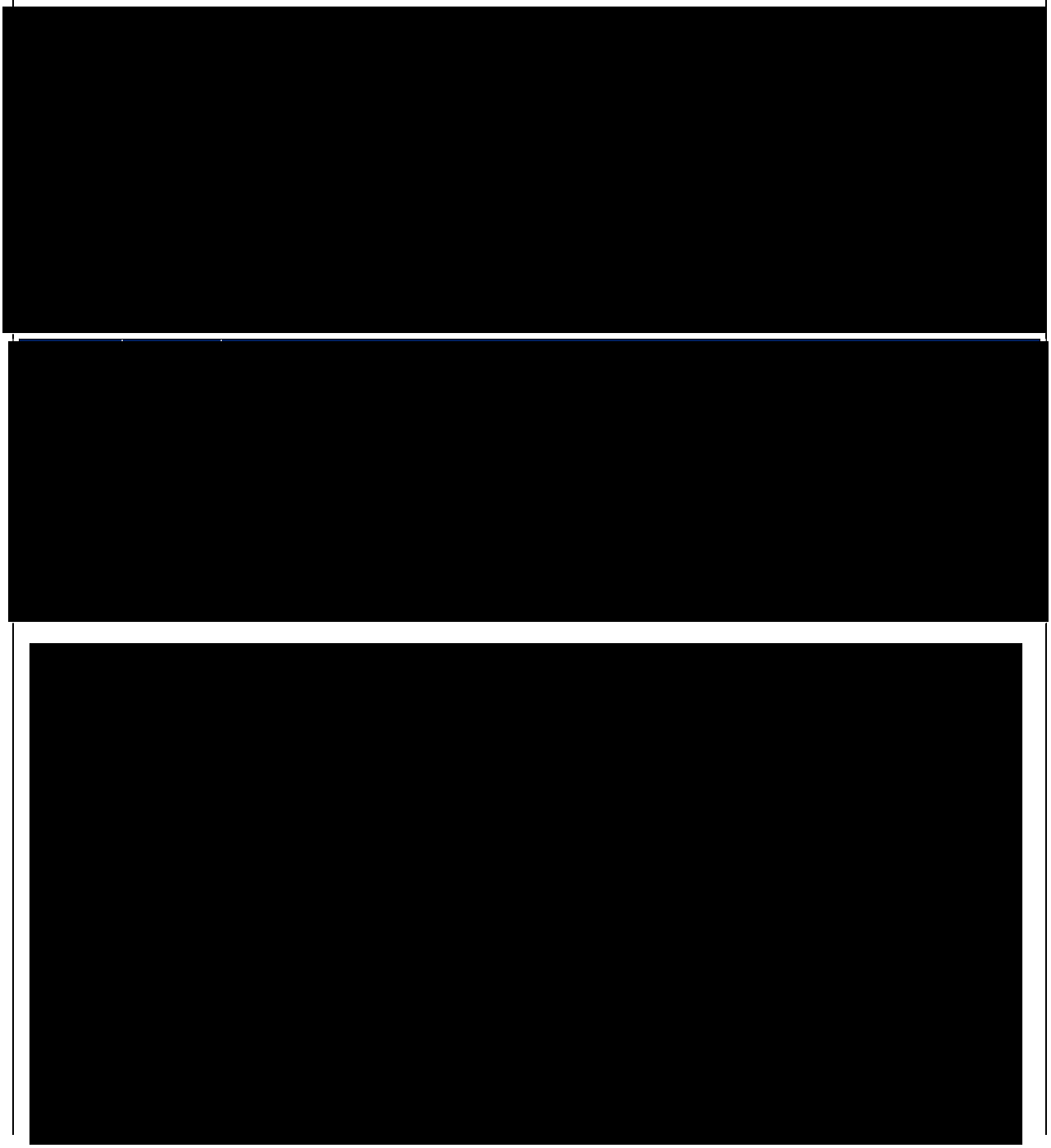
Upon reviewing the Planned Outage Handbook, LEI finds OVEC's outage planning to be thorough and well-documented. Activities involved in each step are laid out in an organized way and responsibilities regarding are clearly assigned to specific personnel.

9.3.4 Actual maintenance costs declined faster than planned costs

Actual outage maintenance costs are charged to AES Ohio customers in the LGR Rider. Therefore, it is important to evaluate the reasonableness and prudency of OVEC's outage costs.

LEI compared the generation assets' non-fuel O&M budget, which includes labor and non-labor/others, to actual maintenance costs for the audit period and 2018-2019. Actual outage maintenance costs were about [redacted] lower than the budgeted costs throughout 2020. In 2019, the outage activities of OVEC-IKEC's generating fleet were [redacted] million, compared to budgeted costs of [redacted] million, which is [redacted] lower than forecasted. In 2020, the cost was about [redacted] million, which is [redacted] lower than the budgeted costs of [redacted] million. Overall, for 2018, 2019, and 2020, budgeted costs and actual costs have declined year-on-year consistently, while the difference between the budgeted costs and actual costs has increased (see Figure 56). In other words, actual costs were consistently lower that OVEC expected.

Figure 56. Maintenance costs for OVEC plants, budget vs actual, 2018-2020



Source: LEI DR 05-007 - Attachment 1 – Confidential.

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

9.3.5 Plant performance

OVEC-IKEC utilizes key indictors or metrics as part of their Open Book Leadership ("OBL") initiative where metrics are reviewed on a weekly or monthly basis with employees. OBL is a management philosophy that OVEC-IKEC 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. OVEC-IKEC utilizes an internal benchmarking process to set performance goals for improvement every year. Key plant metrics for OVEC-IKEC for 2018 through 2020 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.[170]

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

- Heat Rate, an indicator of the efficiency in converting thermal energy from fuel into electrical energy;
- Capacity Factor ("CF"), an indicator of capacity utilization which is defined as the ratio of actual energy output to the maximum possible energy output over a given period of time;
- Equivalent Forced Outage Rate ("EFOR"), a reliability metric defined as the proportion of a period where a unit is not available due to forced outages and forced de-ratings; and
- Equivalent Availability Factor ("EAF"), a reliability metric defined as the proportion of a period where a unit is available without any outages or equipment deratings.

[170] LEI-DR-05-005; LEI DR 05-005 - Attachment 2 - Confidential.

9.3.5.1 Heat rates worsened in 2020

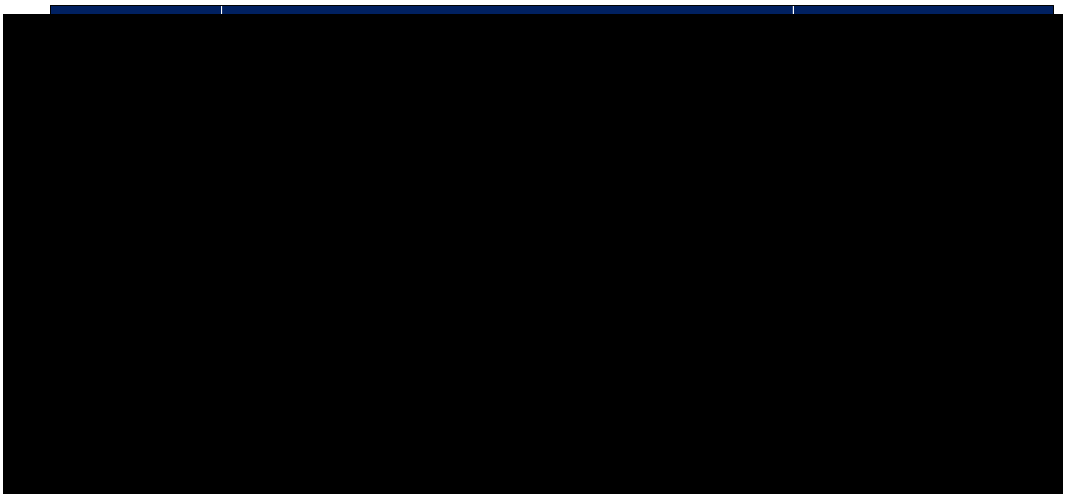
Heat rates, typically expressed in Btu/kWh, measure the efficiency with which a unit converts the energy from fuel into electricity. The lower the heat rate, the more efficient the unit is at generating electricity from a given amount of fuel. Plants with lower heat rates burn less fuel, and so cost 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 audit period (2020) and comparison years (2018 and 2019) (see Figure 57). Nearly all the OVEC units had higher heat rates (were less efficient) than the PJM average every year. The exceptions were Clifty Creek Units 1 and 5, and Kyger Creek Unit 3 in 2019. However, though all units had higher heat rates than the PJM average in 2020, the only unit with a heat rate more than [redacted] higher than the PJM average was Clifty Creek Unit 6.

All the coal units at both plants experienced an increased net heat rate between 2019 and 2020 (worsening efficiency). Lower energy prices in PJM lead to more frequent dispatch at lower operating rates, thereby increasing the heat rates.[171]

Figure 57. Generation unit heat rates (Btu/kWh)



Source: LEI DR 05-004; LEI DR 05-004 - Attachment 1. PJM average heat rate aggregated by S&P Global Market Intelligence.

Note: Highlights in yellow indicate heat rates that are higher than the PJM Average by more [redacted] highlights in red indicate that the year-to-year (2019-2020) increase in heat rates of OVEC plants is [redacted]

[171] Oral presentation from OVEC staff during the virtual plant site visit on November 17, 2021.

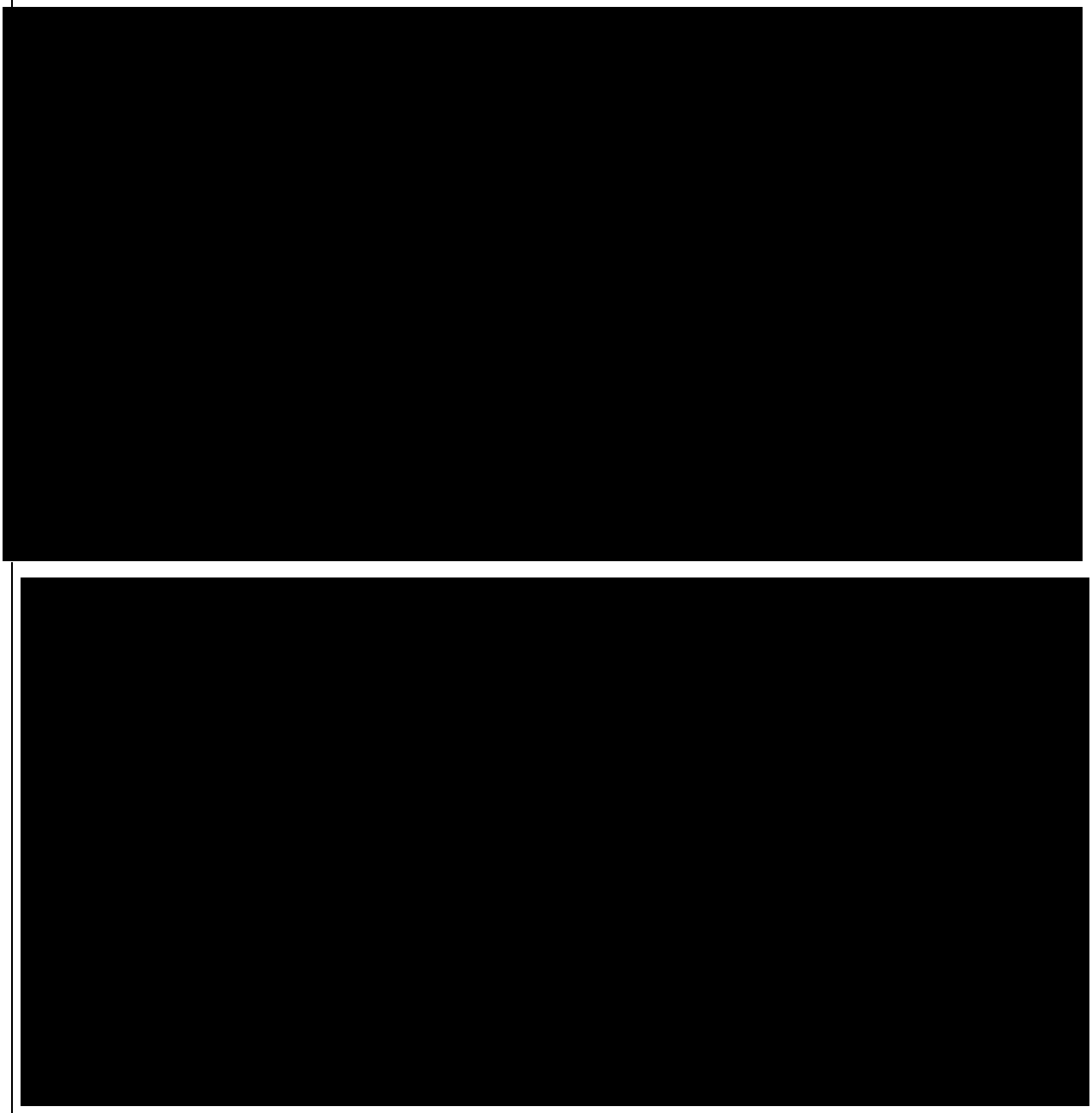
9.3.5.2 OVEC units' capacity factors declined in 2020

The CF is 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 CF.

Net CF ("NCF")[172] all declined in 2020 compared to 2019 (see Figure 58).

[172] Net generation is the gross unit generation less the parasitic (auxiliary) load used by the unit to generate the gross output.

Figure 58. Monthly NCF of OVEC units, 2018-2020



Source: LEI DR 05-005 - Attachment 2 - Confidential.

During the audit period, all plants experienced a year-on-year decline in the NCF, in the range of [redacted] for the Clifty Creek plant and between [redacted] for Kyger Creek (see Figure 59). Despite the decline, with the exception of Clifty Creek Unit 6, all units had CFs [redacted] the average of other PJM coal plants of similar size.

Figure 59. Generation units average annual NCF (%), 2018-2020

Source: Plant data from LEI DR 05-005 - Attachment 2 - Confidential; PJM Average data aggregated by S&P Global Market Intelligence.

Note: Highlights in yellow indicate NCFs that are lower than the PJM average by

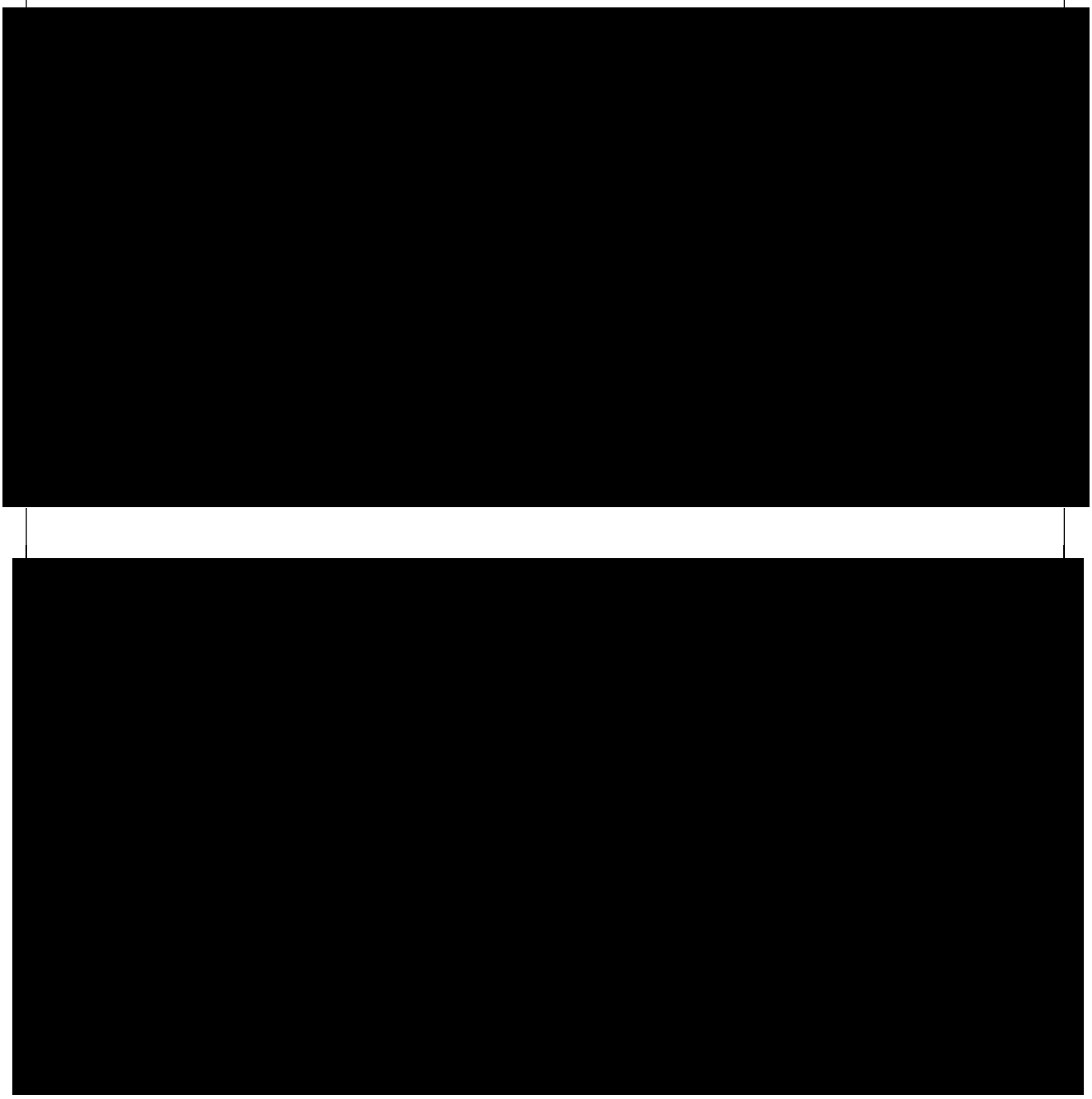
9.3.5.3 EFOR data indicate OVEC plants were more reliable than industry averages in 2020

EFOR reflects the number of hours a unit is forced off-line, compared to the number of hours a unit is running. For example, an EFOR of 5% reflects that the unit or plant is forced off 5% of its running time. A lower EFOR therefore reflects higher a better-maintained plant. During the audit period, the EFOR declined (improved) for four of the six Clifty Creek units and increased (deteriorated) for four of the five Kyger Creek units.

In comparison to the benchmark EFOR demand (EFORd) published by PJM (for coal plants) and weighted EFOR ("WEFOR") published by the NERC (for coal plants), all OVEC units improved EFORs (see Figure 60). WEFOR is a mean outage rate calculated by taking the sum of each unit's capacity weighted forced outage and derate hours divided by the sum of the total equivalent service, outage, and derate hours.[173]

[173] NERC. *2020 State of Reliability Report*. July 2020. p. 38. < https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2020.pdf>

Figure 60. EFOR of OVEC units, 2018-2020



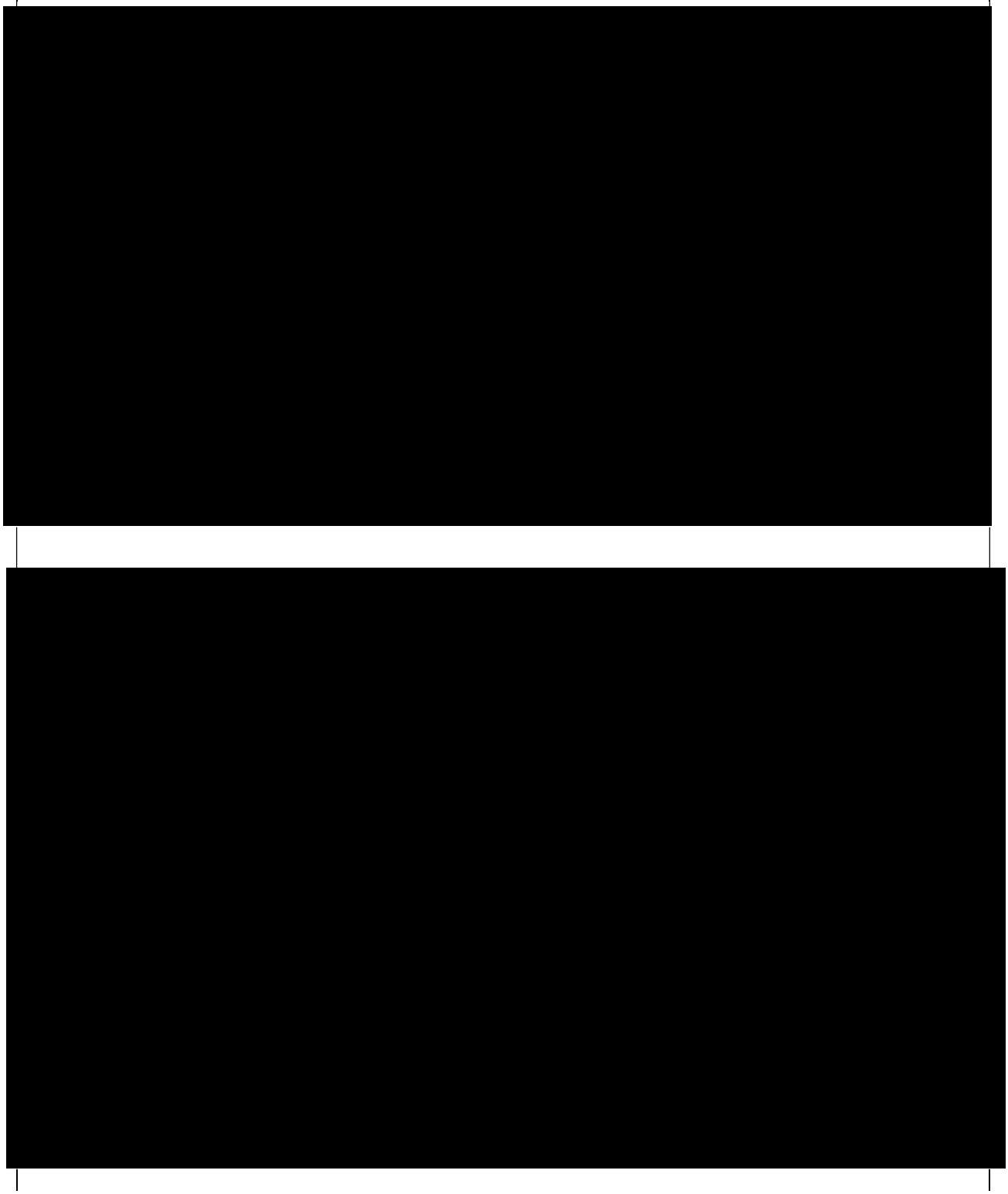
Source: LEI DR 05-005 - Attachment 2 - Confidential; Industry average WEFOR is published annually by NERC for all fuel types including coal. < https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx>; PJM average EFORd is published on the PJM data miner.

Note: Highlights in yellow indicate EFORs that are higher than the industry average by [redacted] while the highlights in red indicate EFORs that are higher than the industry average by more [redacted]

9.3.5.4 EAF data indicates that most of the OVEC plants were available as often as PJM averages

EAF reflects the proportion of a period of time that energy could be generated if limited only by outages and deratings. A higher EAF reflects a better-maintained plant. During the audit period, EAF performance was mixed: EAFs at Clifty Creek Units 1 and 6 improved, but EAFs for Clifty Creek Units 2-5 declined (see Figure 61). EAFs at Kyger Creek Units 1, 2, and 5 improved, while EAFs at Units 3 and 4 declined.

Figure 61. EAFs of OVEC units, 2018-2020



[redacted]

Source: LEI DR 05-009 - Attachment 1 - Confidential; Monitoring Analytics. *2020 State of Market Report – PJM*. p. 44; Monitoring Analytics. *2019 State of Market Report – PJM*. p. 45.

Note: Highlights in yellow indicate EAFs that are lower than the PJM average by [redacted] and highlights in red indicate EAFs that are lower than the PJM average by [redacted]

9.3.6 Emergency procedures and COVID-19 response

OVEV managers reported that the plants each have operating procedures in place for summer and winter readiness, and to deal with local flash flooding if that should occur.[174] Managers reported that the coal piles have never frozen to the point at which they are unusable. However, if needed, coal can be loaded straight into the plants, or re-located to alternate conveyors. With respect to flooding, operators monitor water levels of the Ohio River, and access and escapre plans are in place.

OVEC managers reported that COVID-19 protocols during the audit period included social distancing and mask-wearing, and remote working for non-essential personnel.[175] Managers noted that COVID-19 protocols did not impact OVEC's available personnel to a level that resulted in an inability to operate the plants.

[174] Virtual site visit, November 17, 2020.

[175] Ibid.

9.4 Recommendations

Based on the findings discussed in this section, LEI makes the following recommendations:

- In 2020, low energy prices led to generally lower operating levels and higher heat rates. This may be temporary but was in contrast to the PJM average heat rate, that which actually declined in 2020. AES Ohio, in its role on the OVEC Operating Committee, should monitor performance to ensure efficient operation of the plants.

- During the audit period a few units' EAFs were below PJM averages. LEI recommends that AES Ohio, in its role on the Operating Committee, determine if it is cost-effective to take measures improve availability.

10 Appendix of acronyms

AAAR	Alternate Authorized Account Representative
AAR	Authorized Account Representative
ACES	Alliance for Cooperative Energy
AEC	Atomic Energy Commission
A/S	Ancillary Service
BAT	Best Available Technology
BOD	Board of Directors
BRA	Base Residual Auction
BTU	British Thermal Unit
CAA	1970 Clean Air Act
CAAA	Clean Air Act Amendments
CAIR	Clean Air Interstate Rule
CAMD	Clean Air Markets Division
CAMR	Clean Air Mercury Rule
CCGT	Combined cycle gas turbine
CCR	Coal Combustion Residuals
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 Rule
DA	Day Ahead
DEO	Duke Energy Ohio
DEOK	Duke Energy Ohio and Kentucky
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
ESP	Electricity Security Plan
FERC	Federal Energy Regulatory Commission
FES	FirstEnergy Solutions
FGD	Flue gas desulfurization
FP	Fuel Procurement

HB 6	House Bill 6
HR	Heat Rate
ICPA	Inter-Company Power Agreement
IDEM	Indiana Department of Environmental Management
IKEC	Indiana-Kentucky Electric Corporation
IOUs	Investor-owned utilities
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 LLC
LGR	Legacy generation resource
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
NO_x	Nitrous Oxide
NPDES	National Pollution Discharge Elimination System
O&M	Operations and maintenance
OBL	Open Book Leadership
OFA	Overfire air system
OVEC	Ohio Valley Electric Corporation
PAH	Performance Assessment Hours
PHMSA	Pipeline and Hazardous Materials Safety Administration
PJM	PJM Interconnection
PM	Particulate matter
PPA	Power Purchase Agreement
PPR	Power Participation Ratio
PSR	Price Stabilization Rider
PUCO	Public Utilities Commission of Ohio
RFP	Request for Proposal
RGGI	Regional Greenhouse Gas Initiative
RPM	Reliability Pricing Model
RPS	Renewable Portfolio Standard
RT	Real Time
RTO	Regional transmission organization
SCR	Selective catalytic recovery

SGEE	Steam Generation Equipment Engineering
SO_2	Sulfur Dioxide
SVP	Senior Vice President
VP	Vice President
WEFOR	Weighted EFOR
WWTP	Wastewater treatment plant