Draft Director's Report
For Wabash Valley Power Association (WVPA)
2023 Integrated Resource Plan

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Draft Director's Report Applicable to WVPA's 2023 Integrated Resource Plan and Planning Process

I. PURPOSE OF IRPS

Wabash Valley Power Association's (WVPA) 2023 integrated resource plan (IRP) was submitted on May 10, 2024. By statute[1] and rule, integrated resource planning requires each utility that owns generating facilities to prepare an IRP and make continuing improvements to its planning as part of its obligation to ensure reliable and economical power supply to the citizens of Indiana. A primary goal is a well-reasoned, transparent, and comprehensive IRP that will ultimately benefit customers and the utility. At the outset, it is important to emphasize that an IRP is the utility's plan. The Director's report does not endorse the IRP nor comment on the desirability of the utility's "preferred resource portfolio" or any proposed resource action.[2]

The essential overarching purpose of the IRP is to develop a long-term power system resource plan that will guide investments to provide safe and reliable electric power at the lowest delivered cost reasonably possible. Because of uncertainties and accompanying risks, these plans need to be flexible as well as support the unprecedented pace of change currently occurring in the production, delivery, and use of electricity. IRPs may also be used to inform public policies and are updated regularly.

IRPs are intended to be a systematic approach to better understand the complexities of an uncertain future, so utilities can maintain maximum flexibility to address resource requirements. Inherently, IRPs are technical and complex in their use of mathematical modeling that integrates statistics, engineering, and economics to formulate a wide range of possible narratives about plausible futures. The utilities should utilize IRPs to explore the possible implications of a variety of alternative resource decisions. Because of the complexities of integrated resource planning, it is unreasonable to expect absolutely accurate resource planning 20 or more years into the future. Rather, the objective of an IRP is to bolster credibility in a utility's efforts to understand the broad range of possible risks that utilities are confronting.[3] By identifying uncertainties and their associated risks, utilities will be better able to make timely adjustments to their long-term resource portfolio to maintain reliable service at the lowest reasonable cost to customers.

WVPA, like every Indiana utility and stakeholder, anticipates substantial changes in the state's resource mix due to several factors[4] and, increasingly, Indiana's electric utilities are using IRPs as a foundation for their business plans. Since Indiana is part of a vast interconnected power system, Indiana is affected by the enormity of changes throughout the region and nation.

[1] Indiana Code § 8-1-8.5-3.

[2] 170 IAC 4-7-2.2(g)(3).

[3] In addition to forecasting changes in customer use of electricity (load forecasting), IRPs must address uncertainties pertaining to the fuel markets, the future cost of resources and technological improvements in resources, changes in public policy, and the increasing ability to transmit energy over vast distances to access economical and reliable resources due to the operations of the Midcontinent Independent System Operator (MISO) and PJM Interconnection, LLC (PJM).

[4] A primary driver of the change in resource mix is due to relatively low-cost natural gas and long-term projections for the cost of natural gas to be lower than coal due to fracking and improved technologies. As a result, coal-fired generating units are not as fully dispatched (or run as often) by MISO or PJM. The aging of Indiana's coal fleet, the dramatic decline in the cost of renewable resources, the increasing cost-effectiveness of energy efficiency as a resource, and environmental policies over the last several decades that reduced emissions from coal-fired plants, as well as their economic value, are also drivers of change.

The resource portfolios emanating from the IRPs should not be regarded as being the definitive long-term plan that a utility commits to undertake. Rather, IRPs should be regarded as illustrative or an ongoing effort that is based on the best information and judgment at the time the analysis is undertaken. The illustrative plan should provide off-ramps to give utilities maximum optionality to adjust to inevitable changing conditions (e.g., fuel prices, environmental regulations, public policy, technological changes that change the cost effectiveness of various resources, customer needs, etc.) and make appropriate and timely course corrections to alter their resource portfolios.

II. INTRODUCTION AND BACKGROUND

WVPA is a generation and transmission (G&T) cooperative based in Indianapolis, Indiana, that provides wholesale electricity to 23 members: 19 in the northern half of Indiana, three in Illinois and one in Missouri. In turn, these distribution cooperatives supply electricity to more than 334,000 retail members. Nearly 76% of its retail customer base resides in Indiana, with approximately 16% in Illinois, and 8% in Missouri.

WVPA supplies electric power to six sub-balancing areas through transmission facilities owned by WVPA or by facilities scheduled through the MISO or PJM regional transmission organizations (RTOs). WVPA plans for requirements holistically to avoid oversupply while also meeting reliability needs.

WVPA recognizes that the electricity markets have transformed considerably since the 2020 IRP. The factors driving change include changes to the MISO and PJM resource adequacy capacity constructs, renewed focus on reliability risks, and increasing prevalence of distributed energy resources. For this IRP, WVPA modeled the retirement of coal-fired resources Gibson Unit 5 and Prairie State Unit 1, as well as the Wabash River Highland combustion turbine. In addition, the IRP includes the retirement of Rockport Units 1 and 2 coal-fired resources in 2028 that supply part of WVPA's power purchase agreement with American Electric Power (AEP).

Consistent with the issues discussed above, the Director's report will focus on four broad areas: (1) load forecasting; (2) assessment of demand-side resources broadly defined to include energy efficiency, demand response resources, electric vehicles, and other distributed energy resources; (3) portfolio analysis and the consideration of risk and uncertainty on different resource portfolios; and (4) the use of the Five Pillars[5] in the development of the IRP.

III. LOAD FORECASTING

Methodology Overview

WVPA's load forecast methodology appears to be largely unchanged since its 2020 IRP except for incorporating electric vehicles (EVs) into the base forecast instead of only as an alternative scenario. As a result, the following comments are like those provided in the previous Director's report.

The load forecast is based on constructing member-specific forecast models that account for long-term structural changes as well as expected population and economic growth. WVPA uses an end-

[5] Reliability, Affordability, Resiliency, Stability, & Environmental Sustainability (Indiana Code §§ 8-1-2-0.6 and 8-1-8.5-3.3)

use modeling framework developed by Itron. The approach is to estimate monthly linear regression models that relate system energy and peak demand to constructed end-use variables for heating, cooling, and other use. The constructed model variables reflect increases in population and economic growth, end-use saturation and efficiency changes, and weather conditions.

The forecast is developed at the member system delivered energy level, then disaggregated into residential, commercial and industrial (C&I), and other (primarily street lighting).

Monthly residential billing data is used to construct residential average use and number of customer models for each member system. These are combined to produce estimates of residential energy sales by member. Other use sales models are estimated with simple linear trend specification.

C&I sales are derived as the difference between total member sales and residential and other use sales forecasts. According to WVPA, C&I sales data still are a challenge for modeling as C&I sales are only available on an annual basis for many WVPA members. Pass-Through Loads Customers are large power customers with non-conforming loads that require separate forecasts. Pass-Through Loads Customers are not considered C&I customers for purposes of load forecasting.

WVPA says its forecast accuracy has improved because the methodology is capturing end-use efficiency improvements in both the residential and commercial sectors through member-weighted intensity indices. Forecast models at the individual member level capture the unique customer mix, economics, and weather conditions associated with the member service area.

Large Customer Load Adjustments

According to WVPA, recent large changes in load due to customer actions will not necessarily be adequately captured in regression models based on historical data. As a result, WVPA uses limited adjustments to a specific customer's energy and demand to account for changes in specific customer business activity. These changes may be the result of business expansion/contraction or the addition or loss of a major customer. These spot adjustments are provided by member cooperative staff.

WVPA also forecasts Pass-Through Loads. Pass-Through Loads Customers can customize their power supply portfolio based on respective risk tolerances. A separate forecast is developed for each Pass-Through Loads customer using regression models and information provided by the customer. Pass-Through Loads are not included in the total energy or peak forecast managed by WVPA. However, these large customers are included in WVPA's total planning load because WVPA is ultimately responsible for meeting the large customers' energy requirements and makes purchases at market prices to meet the minimum reliability requirements. WVPA works closely with each large customer to purchase defined products for energy from the bilateral market and/or to purchase additional energy, capacity, and transmission from applicable RTO energy, capacity, and transmission markets. These costs are "passed-through" directly to each customer.

Coincident Peak Model

The coincident peak demand model has a specification like that of the energy models. The difference is that the explanatory variables are constructed using monthly coincident peak-day cooling degree day (CDD) and heating degree day (HDD). Peak-day CDD and HDD are developed by finding the average daily temperature on the day of system peak at the weather station assigned to the member based on geographic location.

Sales to System Model

Member sales are based on the member-system energy requirements forecast. Historical sales to energy ratios are calculated for each member. A simple regression model is used to project the ratio through the forecast period. Member sales forecasts are then developed by multiplying the member energy forecast by the sales to energy ratio forecast. On average, the sales to energy ratio is 0.958 which translates into a system average distribution loss factor of 4.2%.

Alternative Forecasts

In addition to the base case load forecast, WVPA produced two alternative forecasts using high and low population growth projections. Recognizing that some members are experiencing faster growth than others, high and low scenarios are based on member-specific population growth projections. For the high case, WVPA assumed that population grows 50% faster than the base case population growth. Thus, if the base case population growth rate is 0.3% per year, then the high case population growth rate is 0.45% per year. The low case assumes that long-term population growth is 50% lower than the base case. WVPA assumes that the relationship between population and the economic drivers of growth (number of households and GDP) remains the same.

WVPA's base case system energy requirements are projected to grow at an average annual rate of 0.9%. Summer coincident peak demand is projected to increase at an average annual rate of 1.1% over the forecast period. In the high growth forecast, energy grows at a 1.6% annual rate and summer peak grows at an annual rate of 1.9%. In the low growth case, energy requirements increase an average of 0.3% per year and peak demand by 0.3% per year.

To further adjust the base load forecast, WVPA has started to utilize electric vehicle and distributed generation (DG) adjustments in the alternative scenarios. The high growth scenario includes more EV usage and the low growth scenario includes more distributed generation.

Electric Vehicle Growth

WVPA worked with Itron to develop a long-term distributed energy resources (DER) forecast which includes electric vehicles and solar distributed generation.

The U.S. Energy Information Administration (EIA) Annual Energy Outlook and BloombergNEF are two commonly referenced sources for electric vehicle forecasts. Itron used a consensus forecast, averaging the EIA and Bloomberg forecasts to calculate the share of registered light-duty vehicles which are electric. Itron relied on EIA's assumption of total light-duty vehicles per household. Using this data, Itron calculated the average number of cars per household and projected the electric vehicle share.

Total member vehicles are calculated as the product of forecasted customers multiplied by EIA projected vehicles per household. The number of EVs are calculated by applying consensus projected EV vehicle share to the member total vehicle forecast. The share of electric vehicles was projected to increase from 1% to 25% by 2042. This process generated the mid, or reference, case EV forecast. The High EV case forecast was generated in a similar manner but based solely on the BloombergNEF forecast share of electric vehicles. The low case forecast was generated based solely on the EIA Annual Energy Outlook forecasted share of EVs.

EV load impact depends on the amount of energy a vehicle consumes. The annual EV MWh consumption forecast is the product of the EV forecast and the assumed kWh per vehicle.

The impact of EVs on peak demand depends on when and where EVs are charged. Charging profiles were derived from the National Renewable Energy Laboratory's (NREL) EVI-Pro Lite tool. This is a publicly available online tool used to create EV charging profiles. The tool generates typical weekday and weekend 15-minute profiles for six different charging types. Using the six charging profiles, an average home and away from home profile was created for use in WVPA's EV forecast. Itron assumed 90% of vehicle charging occurs at home and 10% away from home.

Distributed Generation

WVPA estimates there is currently 46.8 MW of installed solar capacity in the areas served by its members. Future capacity is projected based on the EIA growth rates for solar capacity for the East North Central Census region. The EIA projected 10-20% year-over-year growth in capacity over the next ten years. WVPA says the impact of existing solar capacity is embedded in the historical load data so only incremental new capacity as of 2024 was used to adjust the load forecast. No high or low solar forecasts were created.

The solar capacity forecast was translated into a solar generation (MWh) forecast by applying monthly solar load factors to the capacity forecast. Monthly load factors were derived from a typical solar load profile for Lafayette, Indiana.

Calculating Load Impacts of DER

Calculating the DER impacts on the WVPA total system load began with a forecast of the baseline hourly loads. The baseline forecast captures the impact of economic and customer growth, federal efficiency standards, and regional estimates of changing saturations of end-use technologies, such as air conditioning and electric water heating. The baseline forecast does not reflect the impact of solar or EV adoption.

The solar and EV MWh forecasts are combined with hourly profiles to generate hourly forecasts, which are consistent with the annual MWh forecasts. The scaled hourly forecasts are then layered on top of the baseline WVPA system forecast to calculate a system forecast which has been adjusted for the impact of future solar and EV adoption.

Director's Comments – Load Forecasting

Commercial and Industrial load is still calculated as the difference between total sales and the sum of Residential and Other. C&I is not modeled, so any error in Residential or Other modeling and forecasting will affect C&I as well. WVPA says this is because C&I sales data is only available on an annual basis for many of its members, but WVPA notes that in the last few years, a majority of WVPA members are more consistently providing monthly C&I sales data. WVPA says it "will continue to perform analysis to evaluate how well each Member's forecast by class compares to actual results and consider implementing a bottom-up C&I model for those Members whose individual load may need improvement and for which monthly C&I data is available." (*See WVPA IRP, pp. 69-70*) *The Director notes the same exact language was used in the 2020 IRP.*

Despite the helpful discussion, the Director still wonders if WVPA can use historic total energy by month, historic residential energy by month, and the data needed to forecast "other" for each member, to derive the monthly C&I history. This derived C&I history could then be used in regression analysis to develop projections of C&I energy requirements. With the forecast approach described by WVPA, only the total retail sales forecast really matters. The forecast of residential and other customer classes only divides up the total retail sales forecast.

WVPA states on page 69 of its IRP, "Although the small and large commercial revenue classes are not specifically modeled, member commercial sales forecasts are consistent with forecast assumptions." What does "consistent with forecast assumptions" mean? The Director appreciates the discussion trying to explain how WVPA evaluates consistency. It is based on professional or expert judgment which is largely informed by the economic forecast. The Director acknowledges that expert or professional judgment is a critical part of any long-term planning process, and WVPA is being explicit about this exercise of judgment.

The load forecast section begins by discussing Commercial and Industrial together and then it just becomes Commercial with no explanation of what Industrial is. For example, page 49 states that C&I is the difference between total member sales and residential and other use sales. However, the similar statement on page 69 says Commercial is the difference between those things. Where did Industrial go? Is Industrial the "large customer adjustments", the Pass-Through Loads, or both? Plus, if C&I is the difference between total sales and the sum of Residential and Other, how are Commercial and Industrial sales split?

On page 58, WVPA states that the Pass-Through Loads are modeled with regression models and information from the customers as well as internal insights. What are the drivers in this regression model? Table 3-15 on page 71 shows the Pass-Through Load forecast as a constant value starting in 2029. This suggests the regression model is only used for the first few years of the forecast. Why? This also means that the forecast never sees any additions or subtractions from large loads in the future. This may be reasonable in the short term, but probably not in the long term.

The load forecast section has an inconsistency in the use of the terms "sales" and "requirements". The description in the section starts out referring to "sales" (and Table 3-2 is even labeled "sales"), but the text right above it referring to it says "requirements". (*See WVPA IRP, p. 51*) Sales and requirements are not the same thing. There is no explanation at that point in the document as to how WVPA goes from sales to requirements, or the reverse in this case. It's not until page 64 that losses are addressed, and it is explained that sales are calculated by multiplying a historical sales-to-energy ratio by the requirements forecast. So, WVPA forecasts requirements and then derives sales. This is not clear from the earlier part of the section that describes everything as sales.

For distribution losses, the text on page 64 states that a "simple regression model is used to project the ratio throughout the forecast period." WVPA then goes on to state that the system average distribution loss factor was 4.2% over the forecast period. Was a regression used, which seems to imply that the loss factor changes over time based on historical trends, or was an average used? If a regression is used, is there a structural reason to believe that value will trend up or down in the future rather than continue to vary around an average? Note that Table 3-16 on page 72 shows 4.2% distribution losses throughout the forecast.

The report says that a regression model was used to project member non-coincident peak to member coincident peak. Historical member load data was used to construct a monthly demand ratio of own peak to coincident peak demand. This monthly data was used in a simple regression model to project the demand ratio over the forecast period. A non-coincident peak demand forecast was developed by multiplying the coincident peak demand forecast with the demand ratio forecast. Same questions here as for distribution losses. (*See WVPA IRP, p. 66*)

General Comments on Load Forecasting

1. The information in Table 2-1 and Graph 2-2 seems inconsistent. The table shows the 2022-2023 winter peak demand was 1648.9 MW and occurred at 7:00 p.m. The graph shows the winter peak demand was approximately 1500 MW and occurred at 8:00 a.m. Note that Table 2-3 and Graph 2-4 for summer peak demand appear to be consistent. (*See WVPA IRP, p. 15*)

2. While using binary variables to account for unknown phenomena will result in a better model fit, the use will not necessarily improve the explanatory capabilities of the forecast. (*See WVPA IRP, p. 63*)

IV. DEMAND-SIDE MANAGEMENT

Summary and Overview

WVPA states that demand-side management (DSM) resources were evaluated on a comparable basis to the supply-side resources. (*See WVPA IRP, p. 88*) WVPA's planning and evaluation of demand response (DR) and energy efficiency (EE) programs is dependent on a collaborative process with its members. The collaboration is done through the Retail Programs and Services (RP&S) Working Group which is comprised of member personnel. The RP&S Working Group and WVPA staff worked with Skytop consulting through 2023 to review EE and DR options using current internal cost estimates and recent program experience.

The screening process consisted of the following steps:

a. *Identifying EE and DR measures and technologies*: WVPA uses several sources of information to identify potential EE measures and DR technologies including member knowledge and experience and National Rural Electric Cooperative Association research.

b. *Determining if measures are consistent with overall goals*: The primary objective of EE and DR at WVPA is to reduce wholesale power costs to its membership.

c. *Assessing Market Potential*: This step involves assessing the potential application of the technology in the WVPA service territory.

d. *Conduct an Economic Evaluation*: WVPA used the five standard DSM cost effectiveness tests for EE analysis and two tests were used for the DR analysis.

e. *Securing Member Approval and Implementation*: The total resource cost (TRC) results were used to recommend programs to the members for total portfolio approval. The EE and DR portfolio covered the period 2024-2026.

WVPA worked with Skytop Consulting to develop a set of 20-year EE and DR savings scenario forecasts for use in the IRP. The forecasts were meant to provide a set of potential savings scenarios that could be achieved over the 20-year planning period based on extrapolations of low, medium, and high growth scenarios informed by secondary research of several market potential studies completed near the WVPA service territory.

Skytop's benchmarking research involved five other utility and/or co-ops recently completed EE and DR potential studies. The research informed how WVPA's current programs align with savings achieved in other jurisdictions and provided targets for what WVPA could achieve with higher levels of spending.

Skytop reviewed recently completed market potential reports for:

a. Hoosier Energy 2023 DSM Potential Study, GDS Associates, 2023.

b. NIPSCO Market Potential Study, GDS Associates, 2021.

c. AES Indiana 2022 Market Potential Study, GDS Associates, 2022.

d. Indiana Michigan Power Company 2021 Potential Study, GDS Associates, 2021.

e. Michigan Energy Waste Reduction Statewide Potential Study (2021-2040), Guidehouse, 2021.

Based on this review, Skytop summarized achievable potential findings and extrapolated EE and DR savings and cost scenarios for the 2023-2042 period. The key metrics utilized in the scenario analysis were:

a. EE savings as a percentage of annual sales by sector

b. DR savings as a percentage of annual summer peak demand savings by sector.

c. Cost per first year kWh savings by sector for EE.

d. Cost per kW savings by sector for DR.

Informed by the benchmarking research, Skytop extrapolated savings and cost projections for EE and DR savings for 2023-2042 by sector (residential and a combined commercial and industrial) for WVPA. For each scenario, the years 2024 to 2026 were anchored to the results of WVPA's DSM plan for 2024-2025. Years 2027 and beyond are extrapolated based on savings percentage and cost benchmarking research. The extrapolations are based on percentages of sales to scale the results to WVPA specific energy and demand sales by sector.

Each scenario has a target percentage of sales, and associated costs, from the benchmarking that the current WVPA programs ramp up to over the planning period of the IRP. The resulting scenarios provide a range of potential EE and DR savings that could be achieved by WVPA depending on the level of funding and retail participation.

WVPA selected the low EE and DR growth scenarios for the IRP as the base scenario. This scenario represents what WVPA believes could be achieved from EE and DR with moderately more funding and expansion over the 20-year forecast. The results assume that a certain percentage of sales for EE and peak demand for DR will be achieved and ramped up over the forecast, then that percentage of sales remains the same for the future years.

IRP Input Development and Bundling

WVPA's IRP model requires an 8760 hourly forecast of the demand savings from EE. All measures were bundled by sector in the IRP model. Skytop used an extrapolated annual savings by sector (residential and C&I) and applied a sector level 8760 hourly load shape profile to develop the 8760 hourly load impacts from EE. The load shapes were sourced from the National Renewable Energy Laboratory. The residential load shape was an HVAC load shape since most residential measures are HVAC-related. The C&I measure mix was much more diverse, so an overall average C&I load shape was used.

Director's Comments – Demand-Side Management

The discussion contained in the IRP document and the material in Appendix H and Appendix I were helpful. However, there are several areas that call for additional information.

WVPA mentions that several market potential studies from other Midwest utilities were used with other considerations based on the experience and knowledge of Skytop to develop potential program information. Since every market potential study (MPS) is tailor-made for each utility considering its specific customer and service territory characteristics (i.e., economics, demographics, customer types, end-uses equipment saturation, etc.), how appropriate is it to use relevant information from a MPS for another utility and apply this information to WVPA's specific case? What type of factors and adjustments were considered to better represent WVPA's characteristics? (*See WVPA IRP, p 92 and Technical Appendix I, p. 11*)

Why did the Wi-Fi thermostat program, launched in mid-2021 and discontinued in 2023, have low-cost effectiveness? What parameters were used to determine that this program was not cost effective? (*See WVPA IRP, p. 35*)

According to Skytop, "the target low growth percentage for residential was 'calibrated' from 0.88% target from the benchmarking results to 0.25% after a ramp up period of six years." Furthermore, "The same percentage of sales is held constant after this year at the target percent." There is little information about this calibration process and how the 0.25% residential percentage of sales was estimated. Also, how appropriate is it to assume that the percentage of sales will be constant in the long-term future? (*See WVPA Technical Appendix I, p. 7*)

Skytop says that "All measures were bundled by sector for simplicity purposes in the IRP model." Why were these measures not bundled together by similar cost, load shapes, or other characteristics? For example, using an overall average C&I load shape for the C&I bundle seems likely to not capture the measures mix load diversity for the C&I sector.

Did the sector bundles consist of one bundle that covered the entire 2023-2042 period? Did the IRP model choose between the four EE and DR potential scenarios (Flat Potential, Low Achievable Potential, Medium Achievable Potential, and the High Achievable Potential)? Or was only one EE and DR scenario made available to the IRP optimization model?

Why is the annual cost of savings for WVPA ($0.36/kWh in 2024$) in year one significantly higher than the average and median costs calculated from the other utilities in the residential sector? (*See WVPA Technical Appendix I, Table 5, p. 17*)

V. PORTFOLIO ANALYSIS

Models

WVPA utilized the PLEXOS® model to evaluate supply-side and demand-side resource options on an equivalent basis. PLEXOS® selects resources to minimize the overall portfolio cost. PLEXOS® LP long-term optimization model, also known as "LT Plan®," and the PLEXOS® medium-term simulation model, also known as "MT Schedule®," were used to find the optimal portfolio of future capacity and energy resources that minimizes WVPA's variable and fixed costs over the 20-year plan horizon for each scenario.

WVPA also develops a financial forecast using a custom-built financial forecasting model. The Budgets and Forecasting Department incorporates production costing results with other corporate costs to develop budget, short-term (3-6 years), and long-term (20 years) financial forecasts.

Method

WVPA modeled potential states of how the world may look over the 20-year planning horizon in four futures: Current Environment, Carbon Reduction, Load Reduction, and Bold Economic Growth.

The Current Environment future assumes current environmental regulation but not the recent EPA carbon emission rule which limits carbon emissions. The Carbon Reduction future assumes stricter restrictions on thermal units which results in all coal power plants being retired and gas units being limited to a 50% capacity factor after 2034. The Load Reduction future assumes a 150 MW load loss in 2030. The Bold Economic Growth future assumes the addition of two 500 MW high load factor loads (95%) such as data centers, one in 2028 and another in 2032.

The IRP optimization program was used to determine the optimal capacity expansion portfolio for each of the four futures.

WVPA then performed two types of risk analyses on the four capacity expansion portfolios optimized for the four potential futures. In the first type of risk analysis, referred to as scenario modeling in the IRP, the four optimized portfolios are evaluated for how they perform in six deterministic scenarios.

The "Current Trends" scenario reflects WVPA's view of the world based on the policies in place at the time of the IRP's development with assumed future commodity prices intended to represent a probable outcome in energy, coal, gas, and capacity markets, and no carbon price assumptions given the uncertainty at the time the IRP was prepared.

The "High Natural Gas Prices" scenario uses the Horizons High Natural Gas Scenario to adjust energy and natural gas prices.

The "Low Natural Gas Prices" scenario uses Horizons Low Natural Gas Scenario to adjust energy and natural gas prices.

The "High Load Growth" scenario assumes stronger development driven by higher population and economic growth. WVPA also assumes faster economic growth will support greater adoption of EVs.

The “Low Load Growth” scenario assumes weaker development in the WVPA territory driven by lower population and economic growth. This weakens electricity demand and causes no EV growth. WVPA also increased DG adoption to further reduce load.

The “Carbon Regulation” scenario mirrors the Carbon Reduction future. In addition, EE, DR, EV, and DG adoption increases.

The performance of the four optimized portfolios across the six scenarios are then compared based on levelized cost of energy in $/MWh. (*See WVPA IRP, Table 5-23, p. 132*)

The second set of risk analysis is stochastic where the four optimized portfolios are tested for how they respond to stochastic movements of values for the following input variables: load, the prices of energy and capacity in the wholesale markets, the price of natural gas, and the price of coal. (*See WVPA IRP, pp. 135-152*). The performance of each of the four portfolios is displayed in tornado charts which quantify the effect of the stochastic movements in these input variables on the portfolio’s production cost ($/MWh).

Director’s Comments - Portfolio Analysis

The modeling of EE and DR resources appears to be inconsistent with how generation resources are evaluated. WVPA states that EE and DR resources are treated as a resource rather than a load reduction (*see WVPA IRP, p. 58*); however, the EE and DR resources are not presented in an equivalent manner to generating resources during the PLEXOS® optimization runs to choose the optimal capacity expansion plans. Rather as explained in Section 4 of the IRP (bottom of page 95), the future trajectory of EE and DR resources is preselected in a screening process prior to the optimization runs.

Although WVPA does perform extensive risk analysis, the deterministic risk scenario analysis would have been of greater value if WVPA had tested the four optimized portfolios for how they performed in the three futures for which they had not been optimized. Also, four of the deterministic risk scenarios chosen for the deterministic risk analysis (the high/low load growth and the high/low natural gas prices) are already modeled in the stochastic risk analysis of the load growth and natural gas variables. So, running the deterministic risk analysis on these four variables seems somewhat redundant.

The short-term action plan on pages 153 and 154 of the IRP is missing a rather significant item, the purchase of a 360 MW natural gas combined cycle (CC) as indicated elsewhere in the report (e.g., on page 113). The 360 MW CC in 2025 appears in all four optimized portfolios.

The discussion of the determination of the preferred portfolio is confusing because the preferred resource plan is presented in Table 5-7 on page 113 of the IRP before even the optimized portfolios for the other three futures have been presented. Also, WVPA presents the preferred portfolio (page 113) before the discussion of the Five Pillars and the portfolio scorecard based on the pillars (pages 121-126).

To add further confusion, the two different types of risk analysis performed by WVPA were presented after both the preferred portfolio was presented and the scorecard results were presented. Again, one is left to wonder whether either form of risk analysis informed the scorecard or the selection of the preferred portfolio.

The Director acknowledges that WVPA discussed how the preferred portfolio compares to the other optimized portfolios in both the scenario risk analysis and the stochastic analysis, but the overall structure of the material could be better.

VI. THE FIVE PILLARS AND THE SCORECARD

WVPA developed a scorecard to incorporate the five attributes or "pillars" for energy infrastructure decisions identified in Indiana Code sections 8-1-2-0.6 and 8-1-8.5-3.3, which include reliability, affordability, resiliency, stability, and environmental sustainability. WVPA compared the ability of the optimized portfolios to reflect the attributes. Snapshot years of 2032 and 2042 were used to indicate results across the planning period.

Attribute (Pillar)	**Metric**
Reliability and Stability	Market dependency for energy purchases based on a percentage of portfolio
Affordability	Comparison of average costs to the Preferred Plan
Resiliency	Diversity of Resources for energy by percentage of portfolio
Environmental Sustainability	Carbon Emissions in terms of metric tons per MWh

a. *Reliability & Stability*: WVPA considers asset ownership and contract certainty ways to ensure reliable resources and grid stability. WVPA measured these factors in terms of market dependency for energy based on a percentage of the portfolio compared to owned and contracted resources for each expansion plan.

   WVPA states that it is not a North American Electric Reliability Corporation registered Transmission Operator or Local Balancing Authority, so it relies on its investor-owned utility transmission partners to monitor and control system conditions. As a result, the stability attribute is consistent across all portfolios, so it is not listed as a comparative metric in the scorecard.

b. *Affordability*: Affordability is measured in terms of the portfolio costs compared to the Preferred Portfolio Plan. The comparison shows annual variances based on average costs for each of the four optimized expansion plans.

c. *Resiliency*: It is defined as the ability to adapt to changing conditions and withstand and rapidly recover from disruptions. WVPA considers maintaining a diverse resource mix as a way to support resiliency by not relying too heavily on one resource type. WVPA measured resiliency through resource diversity for each expansion plan.

d. *Environmental Sustainability*: WVPA measured environmental sustainability in terms of carbon impacts to compare resource plans. Carbon emissions in terms of metric tons per MWh for each of the four expansion plans were used.

Director's Comments – The Five Pillars and the Scorecard

The Director appreciates the discussion in Section 1 of the IRP providing an overview of what is new in this IRP, the changing energy landscape, and the IRP process. What is missing, however, is a discussion of the metrics that will be used to evaluate the results of the IRP analytical process. For example, there is little discussion early in the document on how the Five Pillars will be evaluated and are integrated into the scorecard.

The factors to be considered when evaluating different resource portfolios include both quantitative and qualitative factors. Scorecards are helpful for the evaluation of quantitative factors but are less helpful for qualitative factors. WVPA does an excellent job describing how it evaluated the results of scenario modeling and stochastic analysis, but it is not at all clear that these results are reflected in the scorecard which is based on the Five Pillars. The Director thinks the issue is less one of omission and more one of presentation of the material which is generally well done by WVPA.

The specific metrics included in the scorecard are limited. WVPA used only one metric for each of the four pillars included in the scorecard. Other Indiana utilities are using multiple metrics for each attribute included in the scorecard. The benefit of using multiple metrics is that it provides different perspectives on the performance of the different portfolios across the attributes being considered. There is no right number of metrics to be evaluated for each attribute. In large part this is going to depend on the circumstances the utility faces, but informative metrics are probably more than a single metric for each attribute.