2022 Integrated Resource Plan (IRP)

Public Advisory Meeting #5

10/31/2022

aes Indiana

Agenda and Introductions

Stewart Ramsay, Managing Executive, Vanry & Associates

Agenda

Time	Topic	Speakers
Morning **Starting at 10:00 AM**	Virtual Meeting Protocols and Safety	Chad Rogers, Director, Regulatory Affairs, AES Indiana
	Welcome and Opening Remarks	Kristina Lund, President & CEO, AES Indiana
	IRP Schedule & Timeline	Erik Miller, Manager, Resource Planning, AES Indiana
	IRP Framework Review	Erik Miller, Manager, Resource Planning, AES Indiana
	Risk & Opportunity Metrics	Erik Miller, Manager, Resource Planning, AES Indiana
Break **12:00 PM – 12:30 PM**	Lunch	
Afternoon **Starting at 12:30 PM**	Reliability, Stability & Resiliency Metric	Hisham Othman, Manager, Resource Planning, Quanta Technology
	IRP Scorecard Results	Erik Miller, Manager, Resource Planning, AES Indiana
	Preferred Resource Portfolio & Short-Term Action Plan	Erik Miller, Manager, Resource Planning, AES Indiana
	Final Q&A and Next Steps	

AES Indiana

Virtual Meeting Protocols and Safety

Chad Rogers, Director, Regulatory Affairs, AES Indiana

IRP Team Introductions

AES Indiana Leadership Team

Kristina Lund, President & CEO, AES Indiana

Aaron Cooper, Chief Commercial Officer, AES Indiana

Brandi Davis-Handy, Chief Customer Officer, AES Indiana

Tanya Sovinski, Senior Director, Public Relations, AES Indiana

Ahmed Pasha, Chief Financial Officer, AES Indiana

Tom Raga, Vice President Government Affairs, AES Indiana

Sharon Schroder, Senior Director, Regulatory Affairs, AES Indiana

Kathy Storm, Vice President, US Smart Grid, AES Indiana

AES Indiana IRP Planning Team

Joe Bocanegra, Load Forecasting Analyst, AES Indiana

Erik Miller, Manager, Resource Planning, AES Indiana

Scott Perry, Manager, Regulatory Affairs, AES Indiana

Chad Rogers, Director, Regulatory Affairs, AES Indiana

Mike Russ, Senior Manager, T&D Planning & Forecasting, AES Asset Management

Brent Selvidge, Engineer, AES Indiana

Will Vance, Senior Analyst, AES Indiana

Kelly Young, Director, Public Relations, AES Indiana

AES Indiana IRP Partners

Annette Brocks, Senior Resource Planning Analyst, ACES

Patrick Burns, PV Modeling Lead and Regulatory/IRP Support, Brightline Group

Eric Fox, Director, Forecasting Solutions, Itron

Jeffrey Huber, Overall Project Manager and MPS Lead, GDS Associates

Jordan Janflone, EV Modeling Forecasting, GDS Associates

Patrick Maguire, Executive Director of Resource Planning, ACES

Hisham Othman, Vice President, Transmission and Regulatory Consulting, Quanta Technology

Stewart Ramsey, Managing Executive, Vanry & Associates

Mike Russo, Forecast Consultant, Itron

Jacob Thomas, Market Research and End-Use Analysis Lead, GDS Associates

Melissa Young, Demand Response Lead, GDS Associates

Danielle Powers, Executive Vice President, Concentric Energy Advisors

Meredith Stone, Senior Project Manager, Concentric Energy Advisors

AES Indiana Legal Team

Nick Grimmer, Indiana Regulatory Counsel, AES Indiana

Teresa Morton Nyhart, Counsel, Barnes & Thornburg LLP

Welcome to Today's Participants

Advanced Energy Economy
Barnes & Thornburg LLP
Bose, McKinney & Evans LLP
CenterPoint Energy
Citizens Action Coalition
City of Indianapolis
Demand Side Analytics
Develop Indy | Indy Chamber
Earth Charter Indiana
EDPR North America
Energy Futures Group
Faith in Place
Hallador Energy
Hoosier Energy
IBEW Local Union 1395
Indiana Farm Bureau, Inc.
Indiana Friends Committee On Legislation
Indiana Michigan Power
Indiana Office of Energy Development
Indiana Utility Regulatory Commission
IUPUI
Indiana Office of Utility Consumer Counselor
Key Capture Energy
NIPSCO
NuScale Power
Power Takeoff
Purdue - State Utility Forecasting Group
R3 Renewables
Ranger Power
Rolls-Royce/ISS
Sierra Club
Solar United Neighbors
Synapse Energy Economics
Wartsila

… and members of the AES Indiana team and the public!

Virtual Meeting Best Practices

Questions

- Your candid feedback and input is an integral part to the IRP process.
- Questions or feedback will be taken at the end of each section.
- Feel free to submit a question in the chat function at any time and we will ensure those questions are addressed.

Audio

- All lines are muted upon entry.
- For those using audio via Teams, you can unmute by selecting the microphone icon.
- If you are dialed in from a phone, press *6 to unmute.

Video

- Video is not required. To minimize bandwidth, please refrain from using video unless commenting during the meeting.

aes Indiana

AES Purpose & Values

Accelerating the future of energy, **together**.

Safety first

Highest standards

All together

Safety First

1. AES Indiana strives to provide a place of employment that is free from recognized hazards and one that **meets or exceeds governmental regulations** regarding occupational health and safety.

2. AES Indiana considers occupational health and safety a **fundamental value** of the organization and is a **key performance indicator** of the overall success of the company.

3. AES Indiana's ultimate objective is that each day all AES Indiana people, contractors, and the public we serve return home to their family, friends, and community **free from harm**.

aes Indiana

Meeting our customers’ needs today and tomorrow

AES Indiana
is leading the
inclusive,
clean energy
transition.

Reliability

Affordability

Sustainability

Gradual change to the AES Indiana portfolio over time

2009-2015

Signed 100 MW PPA at Hoosier Wind Park in NW Indiana, 200 MW PPA at Lakefield Wind Farm in Minnesota and 96 MW PPA for solar in Indianapolis through Rate REP

2016

Retired 260 MW of coal at Eagle Valley

2016

Finalized refuel of 630 MW of coal-fired generation at Harding Street to natural gas

2018

Eagle Valley 671 MW Gas-Fired Combined Cycle Plant Completed

2021-2023

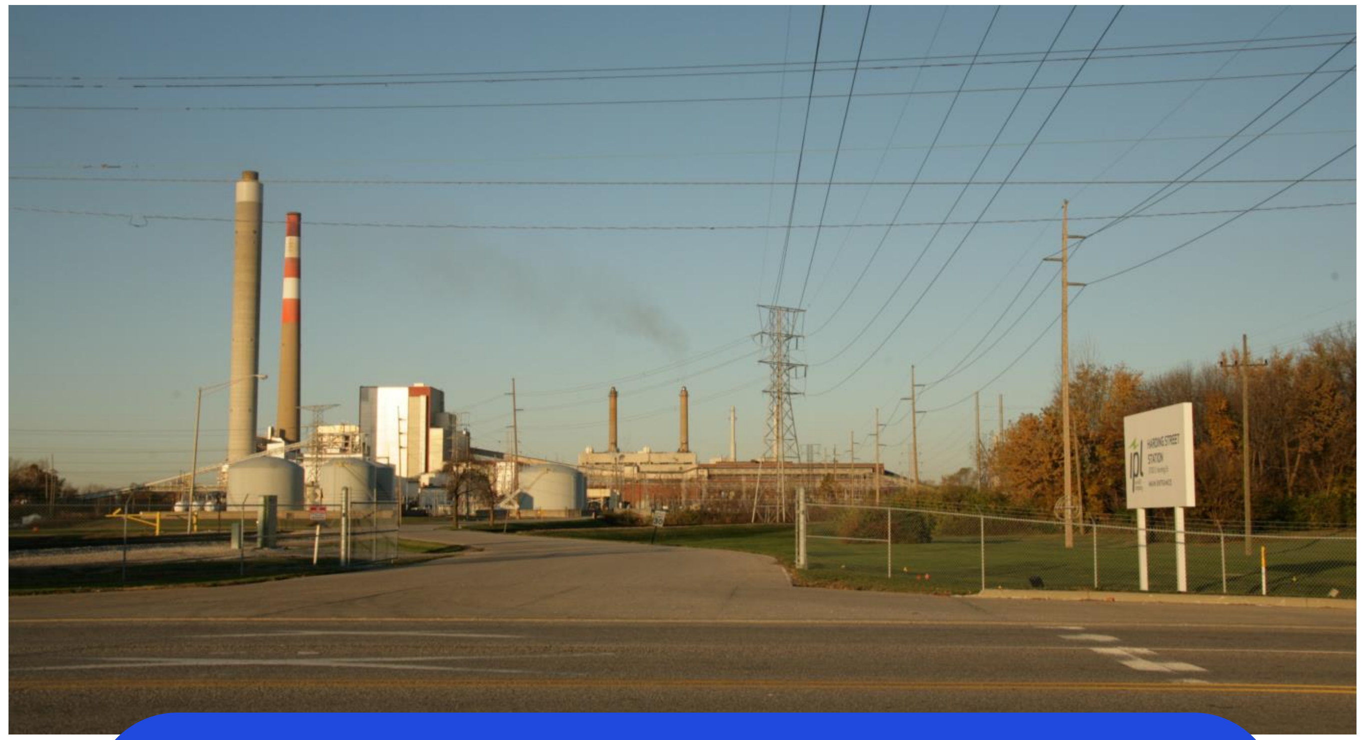
Retired (Unit 1) 220 MW of coal at Petersburg; Plans to retire (Unit 2) 401 MW of coal at Petersburg in 2023

2023 – 2024

Plans to complete 195 MW Hardy Hills Solar project and 250 MW + 180 MWh Petersburg Energy Center solar + storage project

Capabilities and infrastructure of current fleet

Largest sites have valuable capabilities and infrastructure for the energy transition



Petersburg

Experienced, skilled labor force, land, interconnection, water rights, water treatment, natural gas pipelines already present on site

Harding Street

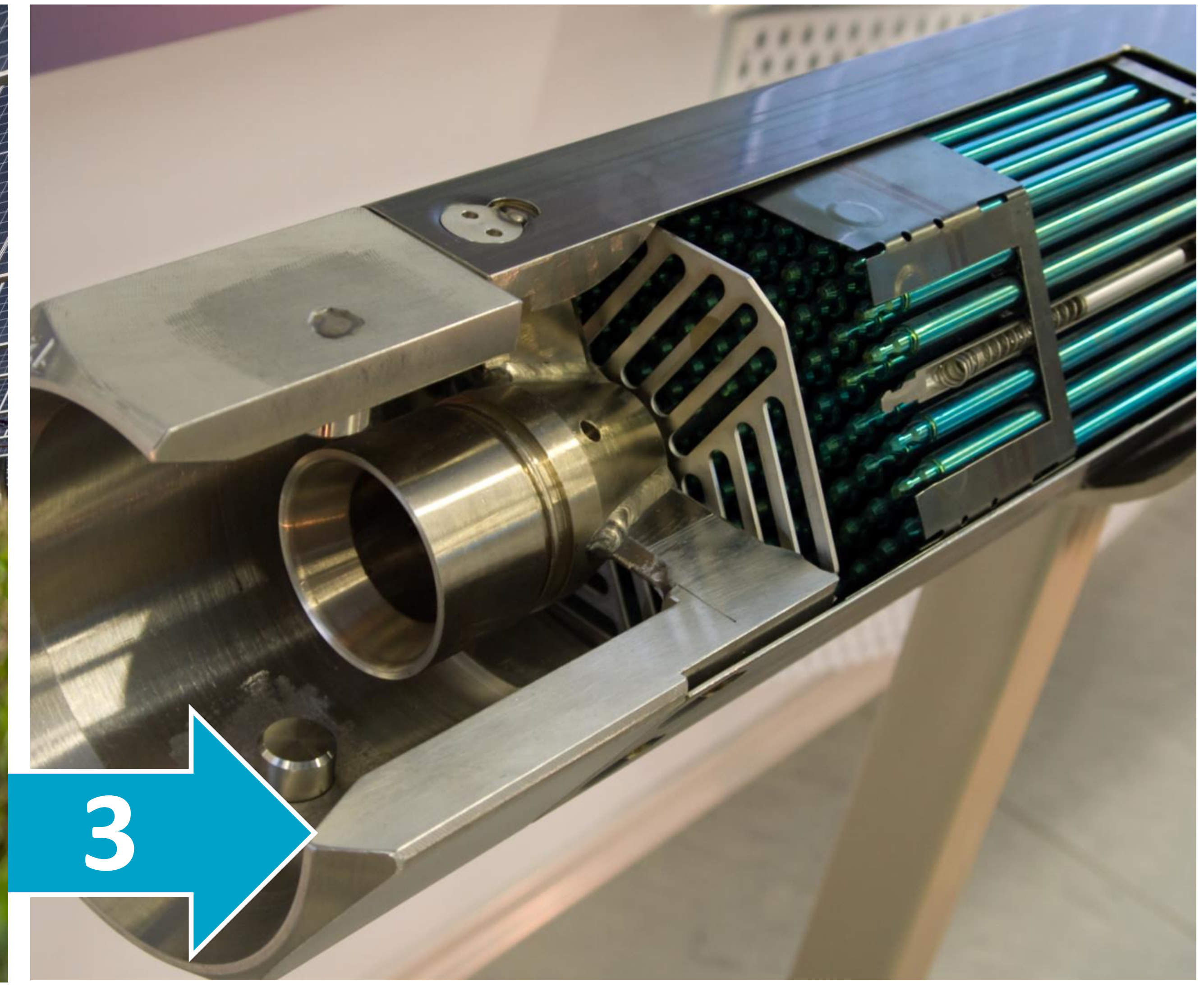
Experienced, skilled labor force, land, interconnection, location near load center, rail, water rights

Eagle Valley

New plant, highly efficient, flexible for future grid changes

AES Indiana seeks to partner with Pike County and City of Indianapolis to drive customer value and community impact of Petersburg and Harding Street Sites.

Short-term Action Plan Uses Existing Capacity and Adds Significant Renewables



CONVERT

Convert Petersburg units 3 & 4 (1,052 MW) to natural gas in 2025 via existing pipeline on site

ADD RENEWABLES

Add up to 1300 MW of wind, solar, and storage as early as 2025

MONITOR

Monitor emerging technologies for inclusion in future planning

PREFERRED PORTFOLIO MAINTAINS OPTIONALITY FOR THE FUTURE

Short-term Action Plan Best Serves Our Customers' Objectives

1

RELIABILITY

- → Highest composite reliability score

2

AFFORDABILITY

- → Saves AES Indiana customers more than $200M

3

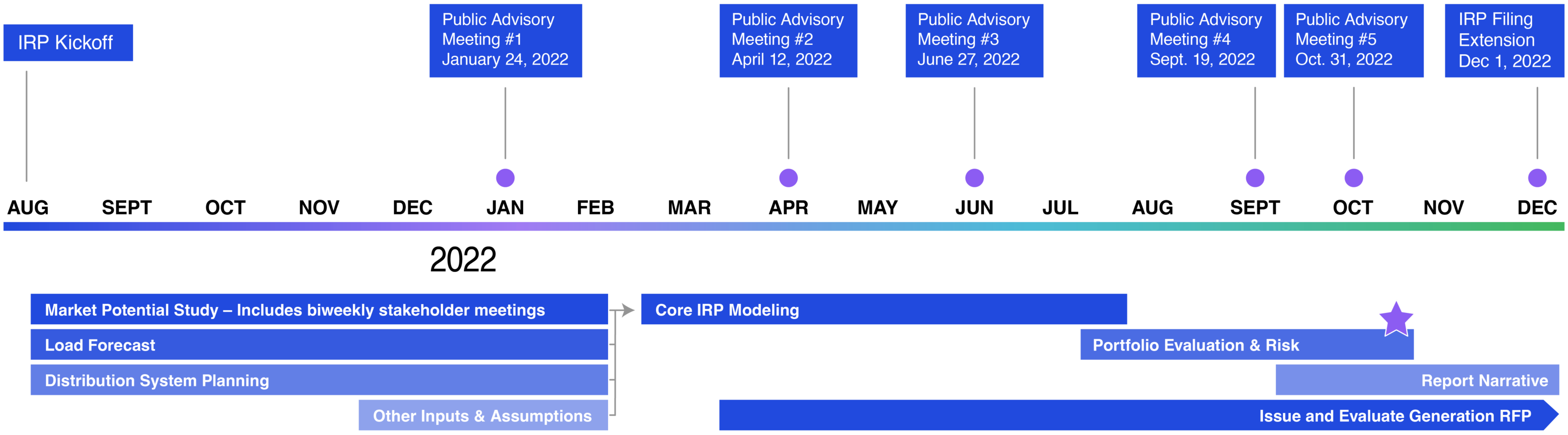
SUSTAINABILITY

- → Provides 68% reduction in carbon intensity in 2030 compared to 2018

IRP Schedule & Timeline

Erik Miller, Manager, Resource Planning, AES Indiana

Updated 2022 IRP Timeline



● = Stakeholder Technical Meeting for stakeholders with executed NDAs held the week before each public stakeholder meeting

★ = Preferred Resource Portfolio selected

AES Indiana is available for additional touchpoints with stakeholders to discuss IRP-related topics.

Public Advisory Schedule

Public Advisory Meeting #1 – January 24, 2022

- 2022 IRP Schedule & Progress
- 2019 IRP Recap
- Load, EV, DG Forecasts
- MPS Overview

Public Advisory Meeting #2 – April 12, 2022

- Load Scenarios
- MPS Results & DSM Inputs
- Replacement Resource Assumptions
- IRP Portfolio Matrix & Scenario Framework

Public Advisory Meeting #3 – June 27, 2022

- Stakeholder Presentations
- Portfolio Metrics & Scorecard Framework
- MISO Reliability Planning
- IRP Reliability Analysis
- Distribution System Plan

Public Advisory Meeting #4 – September 19, 2022

- Preliminary Modeling Results
- Preliminary Scorecard Results

Public Advisory Meeting #5 – October 31, 2022

- Risk & Opportunity Metrics
- Reliability Analysis
- Final Scorecard Review
- Preferred Resource Portfolio & Short-Term Action Plan

Topics for meeting 5 are subject to change.

IRP Process Overview

Core IRP Modeling & Evaluation

DSM Market Potential Study (MPS)
- → End Use Analysis
- → Comprehensive measure list
- → Measure uptake & potentials: MAP & RAP
- → Develop IRP model inputs (bundles)

Replacement Resource Costs
- → Cost assumptions from 2020 RFP and Consultants, e.g. Wood Mackenzie, NREL
- → New RFP issued

Distribution System Planning (DSP)
- → Bottom-up forecast on sample of constrained circuits
- → Assess EV and DG impacts
- → Load shapes inform IRP analysis

Load Forecast
- → Itron SAE Methodology
- → Base, High & Low Scenarios
- → IRP model peak and energy inputs

Capacity Expansion Modeling
- → Retirement and replacement analysis
- → Portfolio optimization

Other Inputs & Assumptions
- → Portfolio and scenario framework
- → Power & Commodity Price Forecasts
- → Model Parameters & Constraints
- → Existing Resources

Production Cost Modeling & PVRR
- → Prod Cost - Portfolio dispatch analysis serve as PVRR inputs
- → Portfolio PVRR analysis
- → Stochastic risk analysis

Portfolio Evaluation & Short-Term Action Plan
- → Screen against Evaluation Criteria
- → Selection of Preferred Resource Portfolio & Short-Term Action Plan

IRP Submission Dec. 1, 2022

IRP-driven Filings
- → DSM Filing
- → Certificate of Public Convenience and Necessity (CPCN) Filing

Contributors:

DSM MPS – GDS Associates
RFP – Sargent and Lundy
DSP – Internal & Conrad Technical Services
Load Forecast – Itron
PVRR Calculations – Concentric
Reliability Analysis – Quanta
IRP Modeling & Evaluation – Internal with ACES & Anchor Power support

IRP Framework Review

Erik Miller, Manager, Resource Planning, AES Indiana

Final Portfolio Matrix

Results from Capacity Expansion Scenario Analysis

Candidate Portfolios

20-Year PVRR (2023$MM, 2023-2042)	Scenarios: No Environmental Action	Scenarios: Current Trends (Reference Case)	Scenarios: Aggressive Environmental	Scenarios: Decarbonized Economy
Generation Strategies: No Early Retirement	$7,111	$9,572	$11,349	$9,917
Generation Strategies: Pete Refuel to 100% Gas (est. 2025)	$6,621	$9,330	$11,181	$9,546
Generation Strategies: One Pete Unit Retires (2026)	$7,462	$9,773	$11,470	$9,955
Generation Strategies: Both Pete Units Retire (2026 & 2028)	$7,425	$9,618	$11,145	$9,923
Generation Strategies: "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)	$9,211	$9,711	$11,184	$9,690
Encompass Optimization without predefined Strategy	$6,610	$9,262	$10,994*	$9,572

Encompass Optimization Results by Scenario:

No Environmental Action	Current Trends (Reference Case)	Aggressive Environmental	Decarbonized Economy
Refuels Petersburg Units 3 & 4 in 2025	Refuels Petersburg Unit 3 in 2025 & Refuels Petersburg Unit 4 in 2027	Refuels Petersburg Unit 4 in 2027 Retires Unit 3 in 2028*	Refuels Petersburg Unit 3 in 2025 & Refuels Petersburg Unit 4 in 2027

**Refueling Pete 3 & 4 at the same time provides cost efficiencies. These efficiencies are not captured when only one unit refuels.*

aes Indiana

Replacement Resource Cost Sensitivity Analysis

Key Takeaways & PVRR Results

- As capital costs increase, fewer renewables are built for their energy value to the portfolio.
- As capital costs increase, newly constructed natural gas becomes more cost effective – less high price volatility with the cost to construct natural gas.
- Across the range of Replacement Resource Costs, refueling Petersburg provides a low PVRR.

20-Year PVRR (2023$MM, 2023-2042)

Generation Strategies	Current Trends *(Reference Case)* Low	Current Trends *(Reference Case)* Base	Current Trends *(Reference Case)* High
No Early Retirement	$9,054	$9,572	$9,876
Pete Refuel to 100% Gas (est. 2025)	$8,698	$9,330	$9,661
One Pete Unit Retires (2026)	$9,081	$9,773	$10,181
Both Pete Units Retire (2026 & 2028)	$8,790	$9,618	$10,178
"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)	$8,787	$9,711	$10,586
Encompass Optimization without predefined Strategy	$8,670*	$9,262	$9,624

Encompass Optimization Portfolios		
Low	**Base**	**High**
Refuels Petersburg Unit 3 in 2025 Retires Unit 4 in 2028*	Refuels Petersburg Unit 3 in 2025 & Refuels Petersburg Unit 4 in 2027	Refuels Petersburg Unit 3 in 2025 & Refuels Petersburg Unit 4 in 2027

**Refueling Pete 3 & 4 at the same time provides cost efficiencies. These efficiencies are not captured when only one unit refuels.*

aes Indiana

Preliminary Scorecard Results

The IRP Scorecard evaluates the **Candidate Portfolios (Strategies in Current Trends/Reference Case)** using metrics that fit into five categories.

	Affordability	Environmental Sustainability						Reliability, Stability & Resiliency	Risk & Opportunity							Economic Impact	
	20-yr PVRR	*CO_2 Emissions*	*SO_2 Emissions*	*NO_X Emissions*	*Water Use*	*Coal Combustion Products (CCP)*	*Clean Energy Progress*	*Reliability Score*	*Environmental Policy Opportunity*	*Environmental Policy Risk*	*General Cost Opportunity **Stochastic Analysis***	*General Cost Risk **Stochastic Analysis***	*Market Exposure*	*Renewable Capital Cost Opportunity (Low Cost)*	*Renewable Capital Cost Risk (High Cost)*	*Employees (+/-)*	*Property Taxes*
	Present Value of Revenue Requirements ($000,000)	Total portfolio CO2 Emissions (mmtons)	Total portfolio SO2 Emissions (tons)	Total portfolio NOx Emissions (tons)	Water Use (mmgal)	CCP (tons)	% Renewable Energy in 2032	Composite score from Reliability Analysis	Lowest PVRR across policy scenarios ($000,000)	Highest PVRR across policy scenarios ($000,000)	P5 [Mean - P5]	P95 [P95 – Mean]	20-year avg sales + purchases (GWh)	Portfolio PVRR w/ low renewable cost ($000,000)	Portfolio PVRR w/ high renewable cost ($000,000)	Total change in FTEs associated with generation 2023 - 2042	Total amount of property tax paid from AES IN assets ($000,000)
1	$ 9,572	101.9	64,991	45,605	36.7	6,611	45%										$ 173
2	$ 9,330	72.5	13,513	22,146	7.9	1,417	55%										$ 211
3	$ 9,773	88.1	45,544	42,042	26.7	4,813	52%										$ 215
4	$ 9,618	79.5	25,649	24,932	15.0	2,700	48%										$ 248
5	$ 9,711	69.8	25,383	24,881	14.8	2,676	64%										$ 262
6	$ 9,262	76.1	18,622	25,645	10.9	1,970	54%										$ 203

Strategies

- **1.** No Early Retirement
- **2.** Pete Refuel to 100% Natural Gas (est. 2025)
- **3.** One Pete Unit Retires in 2026
- **4.** Both Pete Units Retire in 2026 & 2028
- **5.** "Clean Energy Strategy" – Both Pete Units Retire and replaced with Renewables in 2026 & 2028
- **6.** Encompass Optimization without Predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027

- In Meeting #4 – we reviewed a partially completed Scorecard
- **Today, we will review the remaining metrics and completed Scorecard.**
- **The Meeting will conclude with review of the Preferred Resource Portfolio and Short-term Action Plan**

Risk and Opportunity Metrics

Erik Miller, Manager, Resource Planning, AES Indiana

Risk & Opportunity Metrics

AES Indiana included four **Risk & Opportunity Metrics** on the IRP Scorecard. Analyses were performed on the Candidate Portfolios to quantify these metrics – analyses include:

- Environmental Policy Sensitivity Analysis
- Cost Risk & Opportunity Metric **Stochastic Analysis**
- Market Interaction/Exposure Analysis
- Renewable Resource Capital Cost Sensitivity Analysis

The following slides will review the results from each analysis performed to quantify these metrics.

Risk & Opportunity Metrics:

Environmental Policy Sensitivity Analysis

- AES Indiana modeled environmental policy sensitivities on the optimized capacity expansion results from the Candidate Portfolios (Current Trends/Reference Case) to understand how the PVRR may change using different environmental policy and commodities.
- The results will help to answer the question – "How would the optimized Reference Case perform in a very different policy future, e.g. Reference Case in a Decarbonized Economy future?"

		Current Trends – Reference Case	No Environmental Action	Aggressive Environmental	Decarbonzied Economy
Generation Strategies	No Early Retirement	→			
	Pete Refuel to 100% Gas (est. 2025)	→			
	One Pete Unit Retires (2026)	→			
	Both Pete Units Retire (2026 & 2028)	→			
	Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)	→			
	Encompass Optimization without predefined Strategy	→			

Run the Optimized Reference Case Portfolios/Generation Mixes through the other Scenarios

Metrics

For each strategy, the analysis will capture:

- Risk potential using the **highest scenario PVRR for each strategy**
- Opportunity potential using the **lowest scenario PVRR for each strategy**

Environmental Policy Sensitivity Analysis

- **Env Policy Opportunity Metric** – the environmental policy and commodity assumptions in the No Environmental Action Scenario results in the lowest PVRR in all strategies because this scenario has no carbon price and low gas prices.
- **Env Policy Risk Metric** – the environmental policy and commodity assumptions in the Aggressive Environmental Scenario results in the highest PVRR because this scenario has a high carbon price ($19.47/ton) starting in 2028 and high gas.

		Current Trends – Reference Case	No Environmental Action	Aggressive Environmental	Decarbonized Economy
Generation Strategies	No Early Retirement	$9,572	$8,860	$11,259	$9,953
	Pete Refuel to 100% Gas (est. 2025)	$9,330	$8,564	$11,329	$9,699
	One Pete Unit Retires (2026)	$9,773	$9,288	$11,462	$10,084
	Both Pete Units Retire (2026 & 2028)	$9,618	$9,135	$11,392	$10,334
	Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)	$9,711	$9,590	$11,275	$9,776
	Encompass Optimization (Refuel in 2025 & 2027)	$9,262	$8,517	$11,226	$9,721

Lowest PVRR Opportunity Potential

Highest PVRR Risk Potential

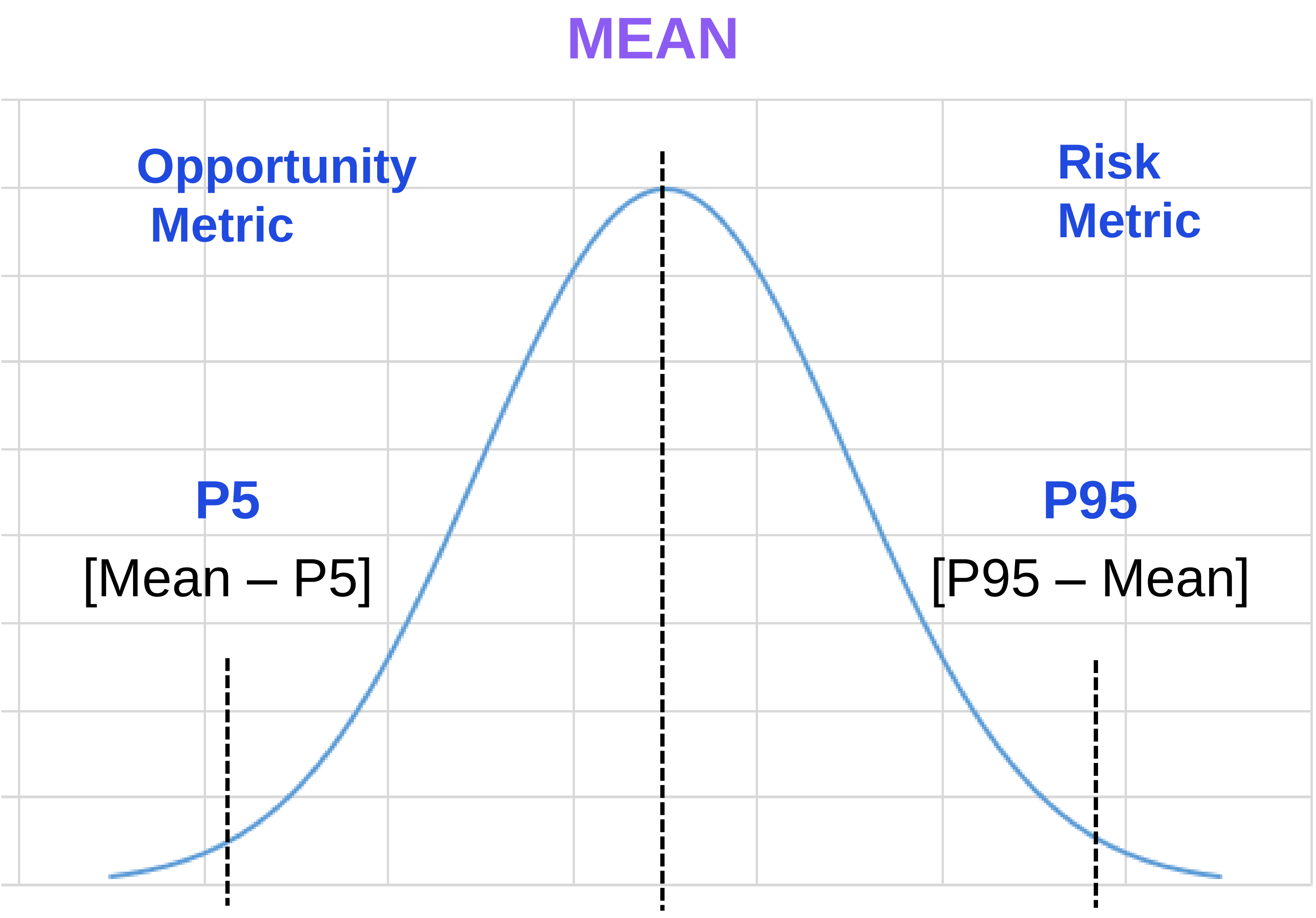
Key takeaways/explanations

- Low gas prices and no carbon price drive the Pete Refuel to be the least cost portfolio in the No Env Action scenario.
- Low-capacity factor due to negative spark spreads (power and gas) drives the Pete Refuel to be the least cost portfolio in the Decarb Econ scenario – *portfolio has low energy from gas units and high energy from renewables to meet RPS.*
- Base coal prices dampen the impact of higher carbon prices and higher NOx, which results in comparatively low PVRR for No Early Retirement in the Agg Env scenario.

aes Indiana

Cost Risk & Opportunity Metric **Stochastic Analysis**

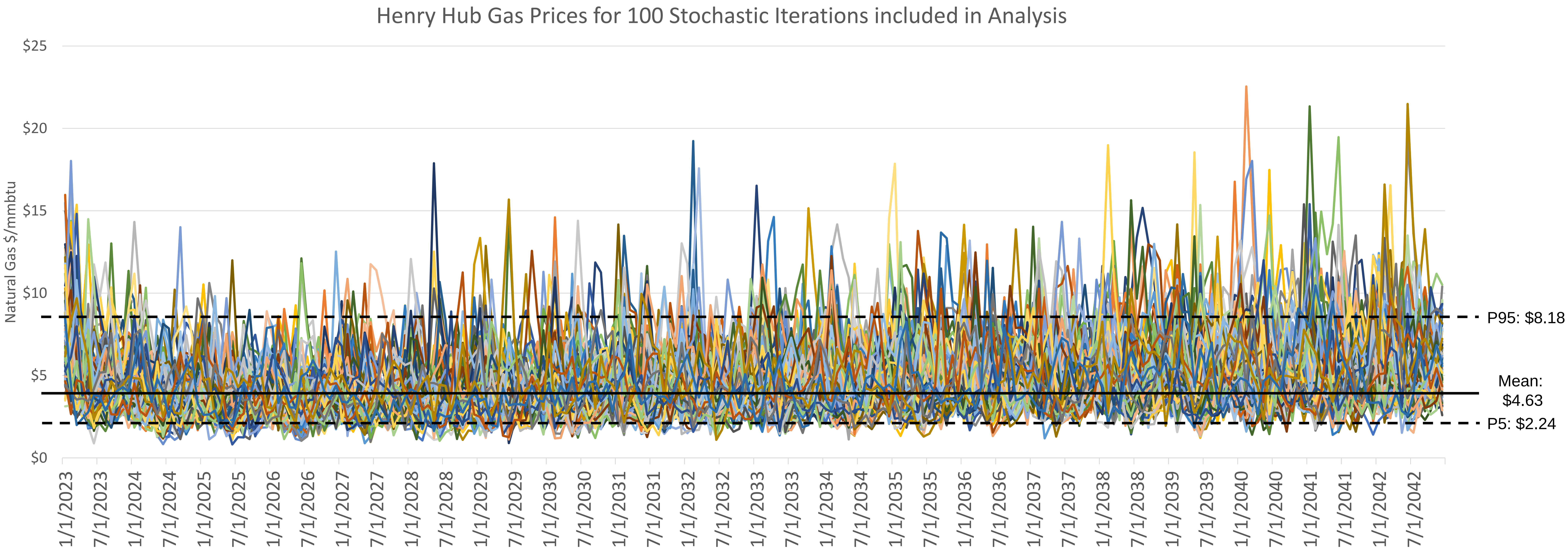
- Stochastic analysis was performed on the **Candidate Portfolios** to understand the risks and opportunities to each Strategy from:
  - Energy price volatility
  - Gas price volatility
  - Coal price volatility
  - Load volatility
  - Renewable generation volatility
- Each variable was varied across a full stochastic distribution using 100 iterations of potential outcomes.
- Metrics to measure cost risks and cost opportunities include:
  - Risk Metric = P95 and [P95 – Mean]
  - Opportunity Metric = P5 and [Mean – P5]



Risk & Opportunity Metrics:

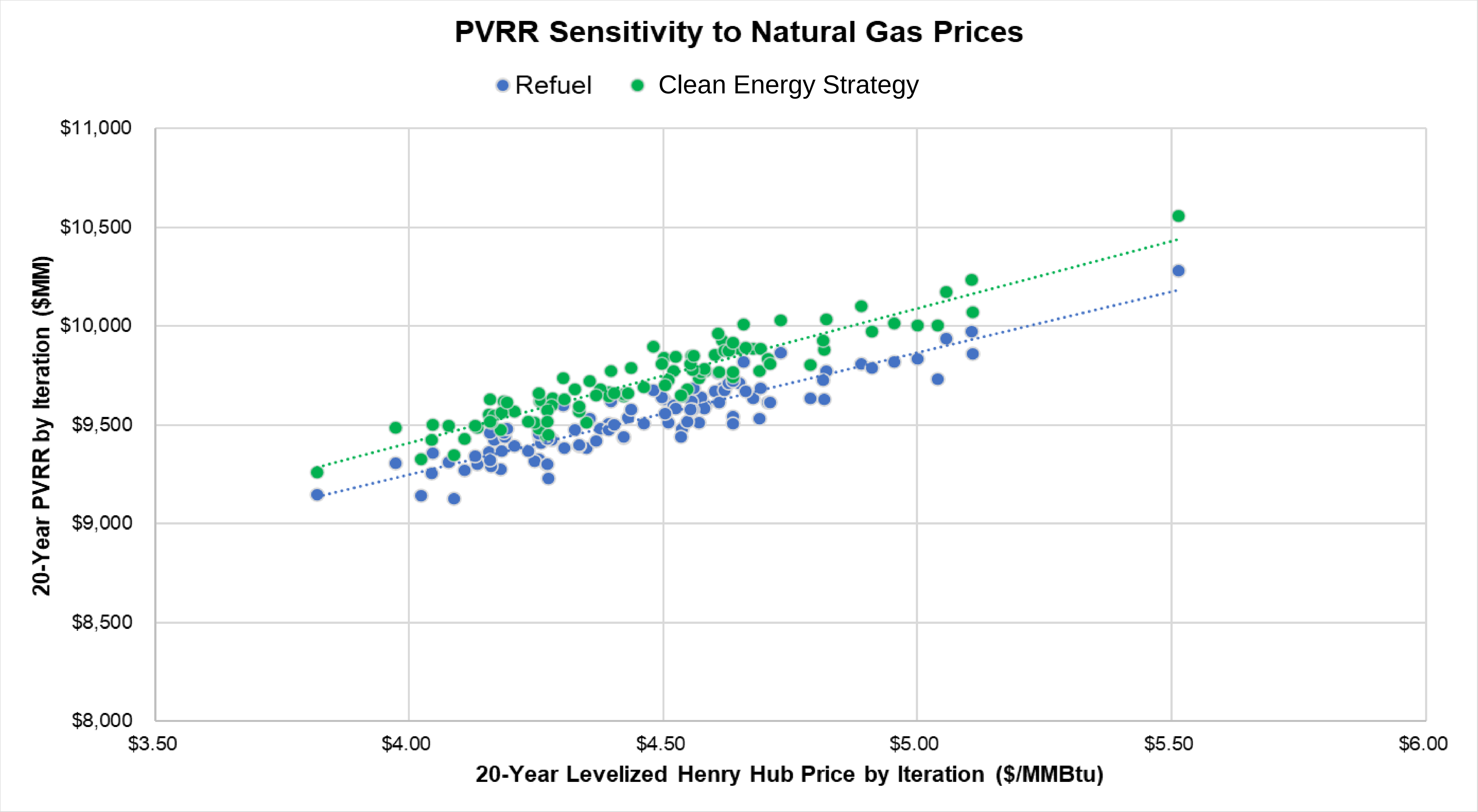
Cost Risk & Opportunity Metric **Stochastic Analysis**

In order to fully evaluate commodity risk, the stochastic analysis captures recent volatility in commodity prices in forecasted distributions.



Cost Risk & Opportunity Metric **Stochastic Analysis**

All Candidate Portfolios rely partly on gas generation and therefore exhibit sensitivity to gas price volatility.



Risk & Opportunity Metrics:

Cost Risk & Opportunity Metric **Stochastic Analysis**

- For the stochastic analysis, AES Indiana lifted the energy constraints in Encompass to fully assess portfolio risk which results in a slightly different mean compared to the deterministic results.
- Risk: P95 – Indicates that 95% of potential PVRRs will fall below this value – there's a 5% chance PVRR will be higher.
- Opportunity: P5 – Indicates 95% of PVRRs will fall above this value – there's a 5% chance PVRR will be lower.

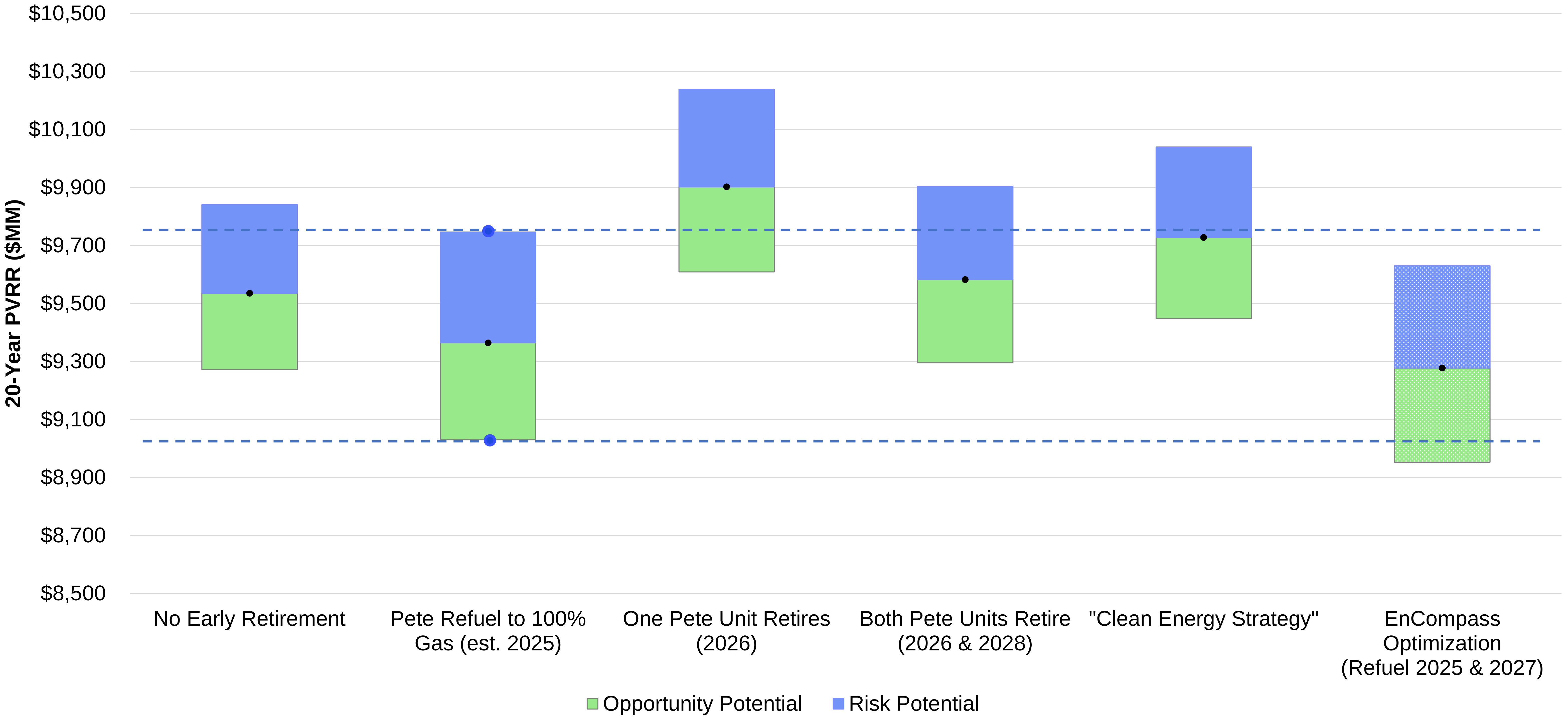
Stochastic results from varying power prices, gas prices, coal prices, load and renewable generation.

Portfolio	Scorecard PVRR Metric	Mean ↓	Opportunity: P5 [Mean - P5]	Risk: P95 [P95 - Mean]
No Early Retirement	$9,572	$9,535	$9,271 [-$264]	$9,840 [$305]
Pete Refuel to 100% Gas (est. 2025)	$9,330	$9,364	$9,030 [-$334]	$9,746 [$382]
One Pete Unit Retires (2026)	$9,773	$9,902	$9,608 [-$294]	$10,237 [$336]
Both Pete Units Retire (2026 & 2028)	$9,618	$9,582	$9,295 [-$287]	$9,903 [$321]
"Clean Energy Strategy"	$9,711	$9,727	$9,447 [-$280]	$10,039 [$312]
EnCompass Optimization (Refuel 2025 & 2027)	$9,262	$9,277	$8,952 [-$324]	$9,629 [$352]

aes Indiana

Risk & Opportunity Metrics:

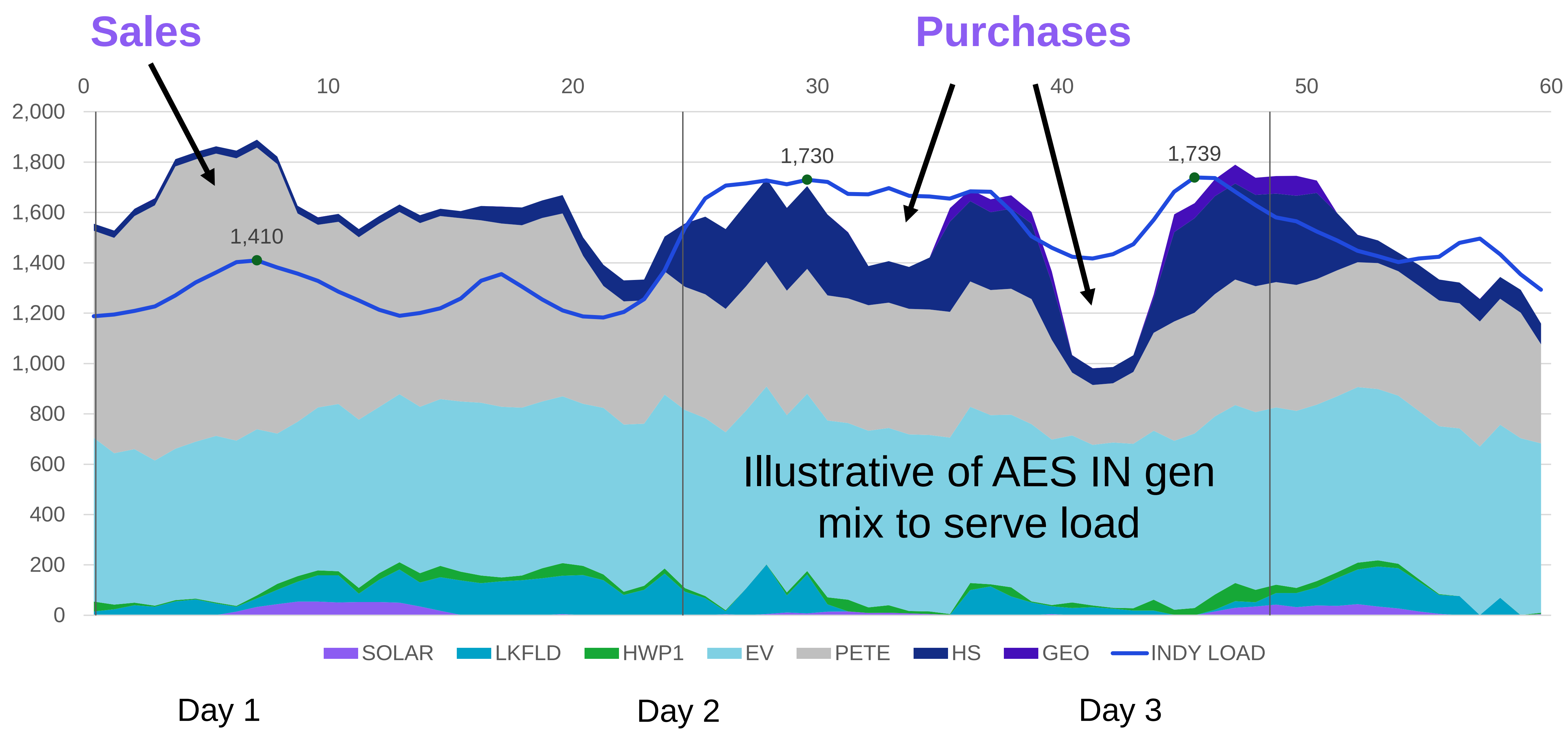
Cost Risk & Opportunity Metric **Stochastic Analysis**



- Converting Petersburg to natural gas provides lowest PVRR at the P95 (risk) and the lowest PVRR at the P5 (opportunity) compared to the other strategies.
- Converting Petersburg to natural gas exhibits the widest distribution due to gas price volatility.
- Continuing to operate Petersburg on coal provides the tightest distribution because coal prices are subject to less volatility compared to other commodities.

Market Interaction/Exposure

- When a utility generates energy in excess of load, the energy is sold into the market. Conversely, when a utility is short energy, the utility must purchase energy to supply load.
- Generally, the less sales and purchases in a portfolio, the less risky the portfolio or strategy is for the customer because the sales and purchases aren't exposed to price volatility in the market.
- For example – what if prices drop to zero when wind is available in excess of load or what if prices spike when energy purchases are needed to meet load?



Market Interaction/Exposure Metric

To estimate this risk for each strategy, AES Indiana calculated the average of the absolute value of the annual sales and purchases and summed those over the 20-yr period.

| 20-year Average Sales | + | 20-year Average Purchases |

Risk & Opportunity Metrics:

Market Interaction/Exposure Results

20-year Average Sales + 20-year Average Purchases = Market Interaction/Exposure Metric

Candidate Portfolios (Strategies in Current Trends/Ref Case)	20-yr Annual Avg Market Sales (GWh)	20-yr Annual Avg Market Purchases (GWh)	Market Interaction/Exposure (GWh)
No Early Retirement	2,935	2,356	5,291
Pete Refuel to 100% Natural Gas (2025)	2,346	2,877	5,222
One Pete Unit Retires in 2026	2,916	2,821	5,737
Both Pete Units Retire in 2026 & 2028	2,921	2,591	5,512
"Clean Energy Strategy"*	3,146	2,942	6,088
Encompass Optimization**	2,285	2,851	5,136

*Both Pete Units Retire and replaced with Renewables in 2026 & 2028

**Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027

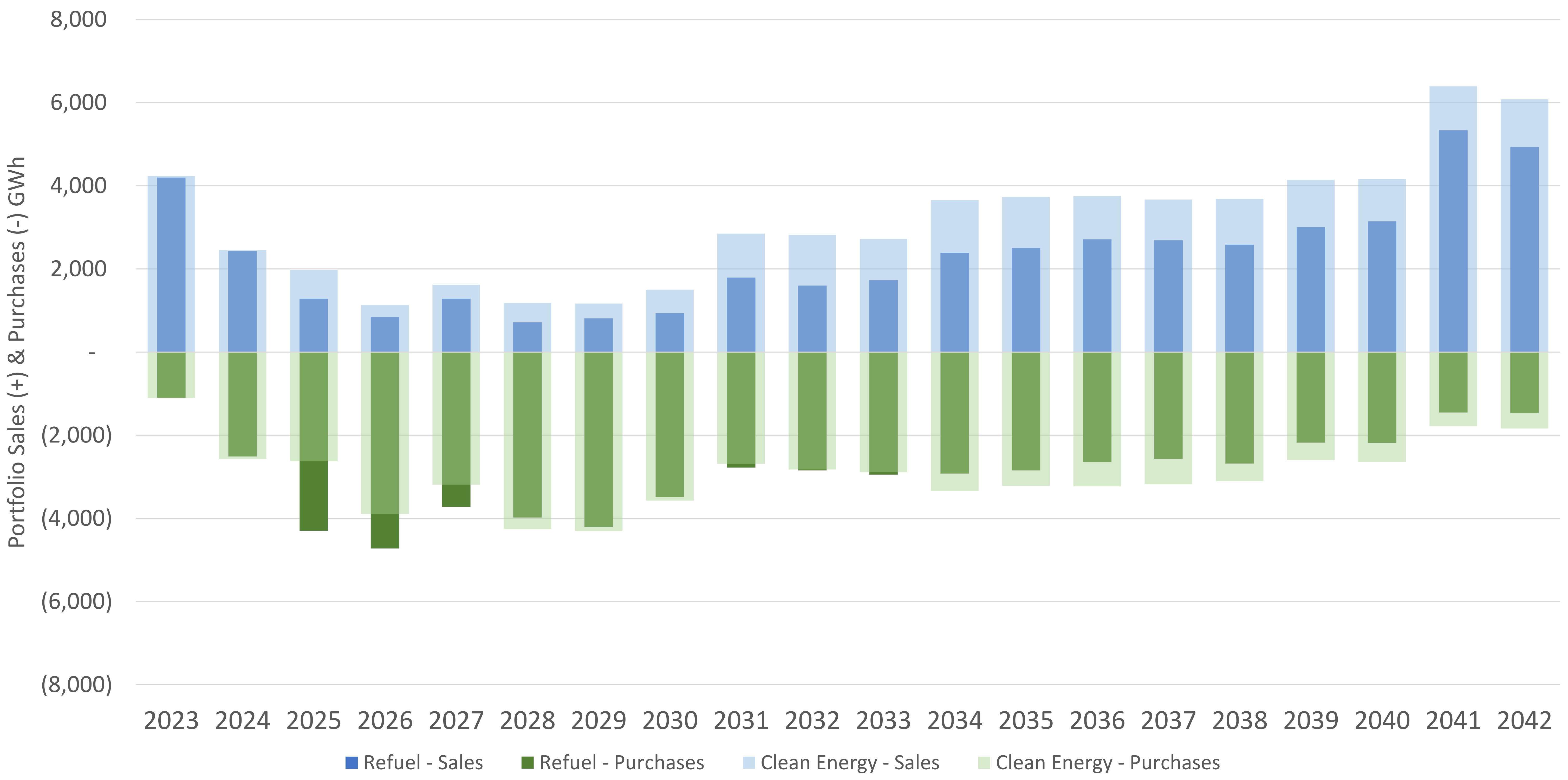
Comparing across strategies, we see portfolios with less dispatchable generation have higher market interaction in the form of energy sales.

Risk & Opportunity Metrics:

Market Interaction/Exposure Example and Comparison

- Strategies with less dispatchable generation typically have higher market interaction in the form of sales due to inability to control when energy is generated.
- In the near term, the Clean Energy Strategy adds more renewables to replace Petersburg, resulting in comparatively higher sales.
- Starting in 2031, both strategies add similar amounts of renewables, so we see sales grow somewhat proportionally.

Market Interaction Comparison – Pete Refuel Strategy vs Clean Energy Strategy



AES Indiana

Risk & Opportunity Metrics:

Renewable Resource Capital Cost Sensitivity Analysis

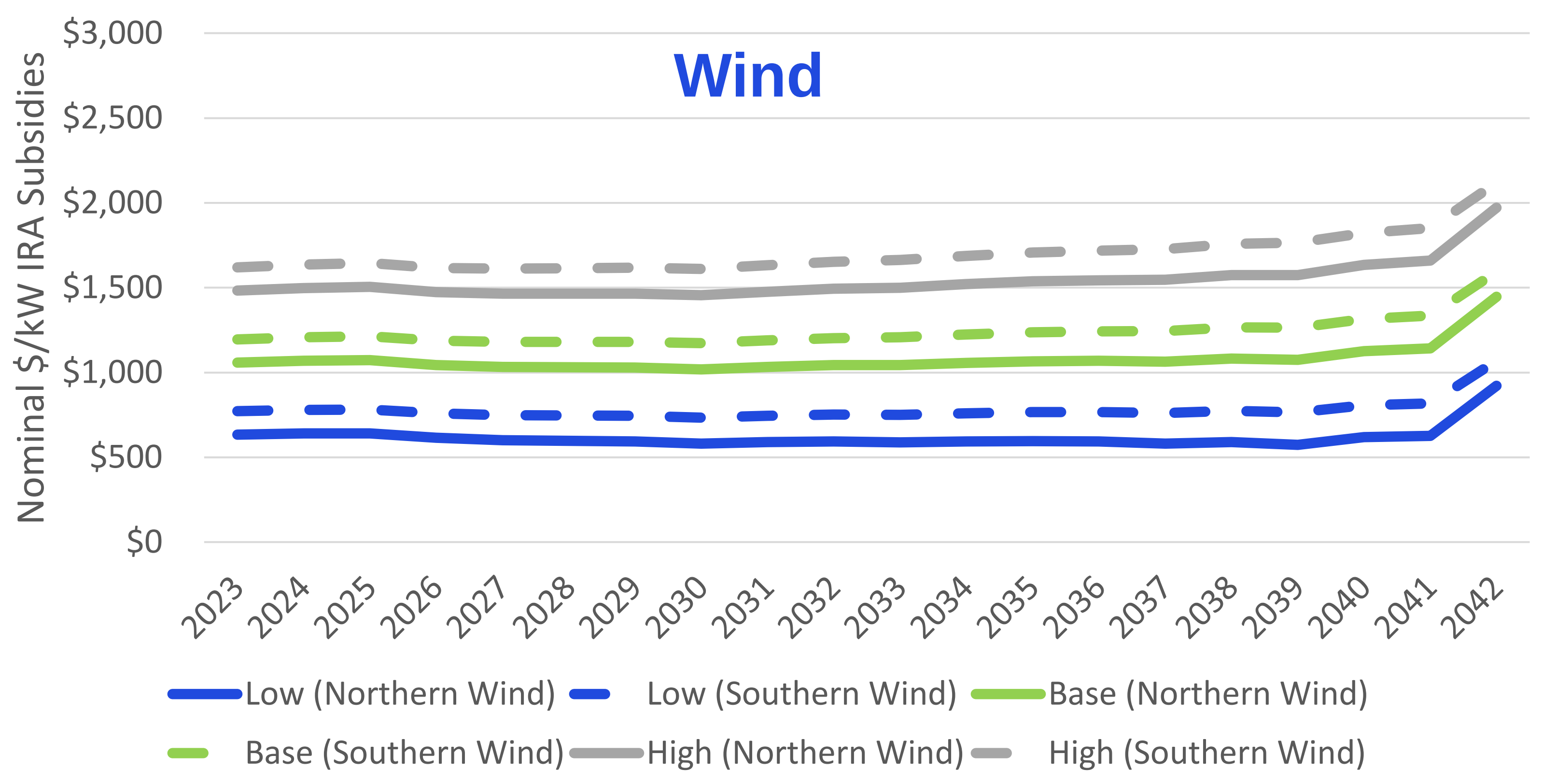
The Renewable Resource Capital Cost Sensitivity Analysis evaluates how much the Candidate Portfolio's PVRRs would change if renewable resource costs end up being higher or lower than the base assumptions.

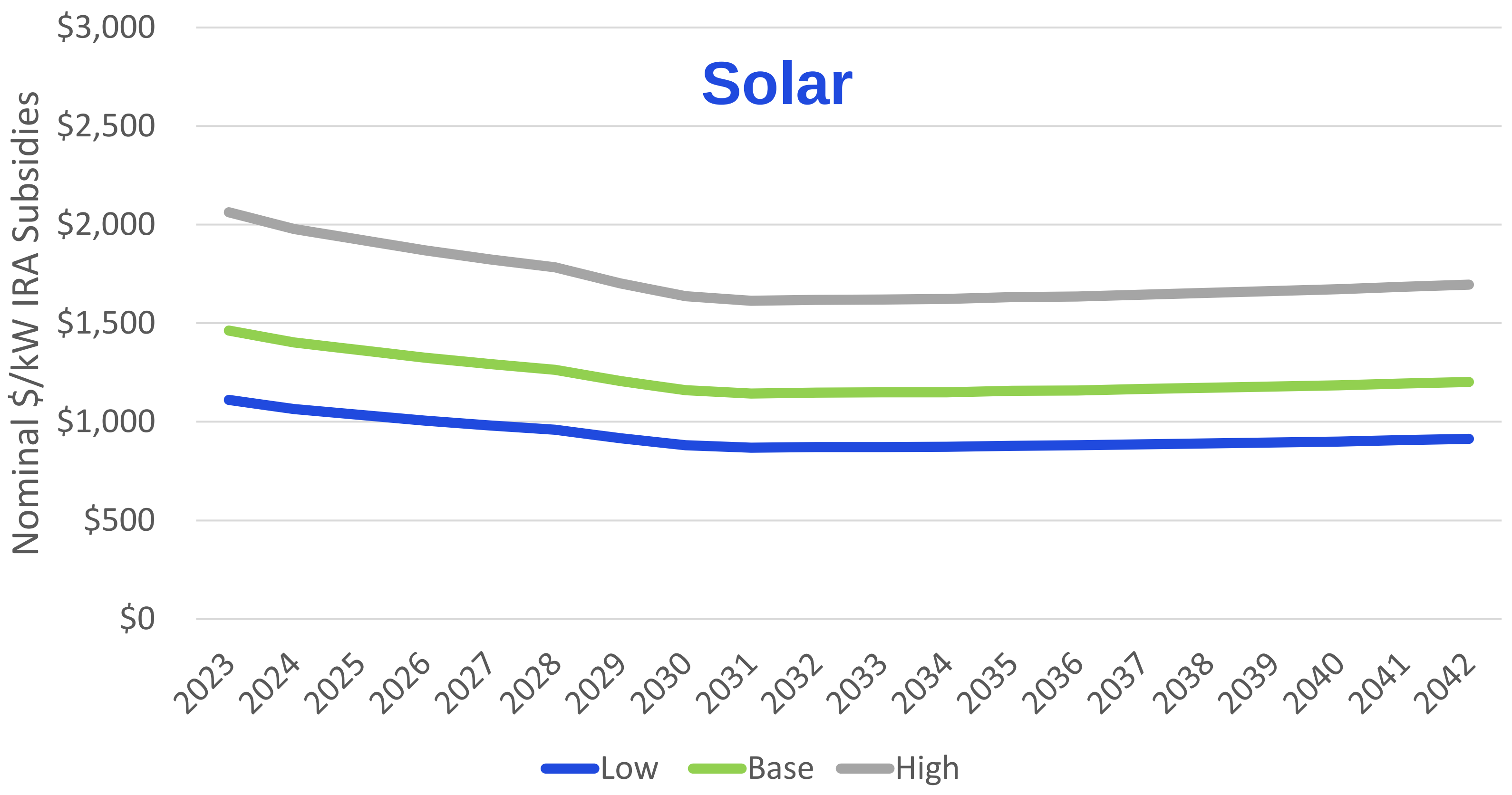
How the analysis was performed

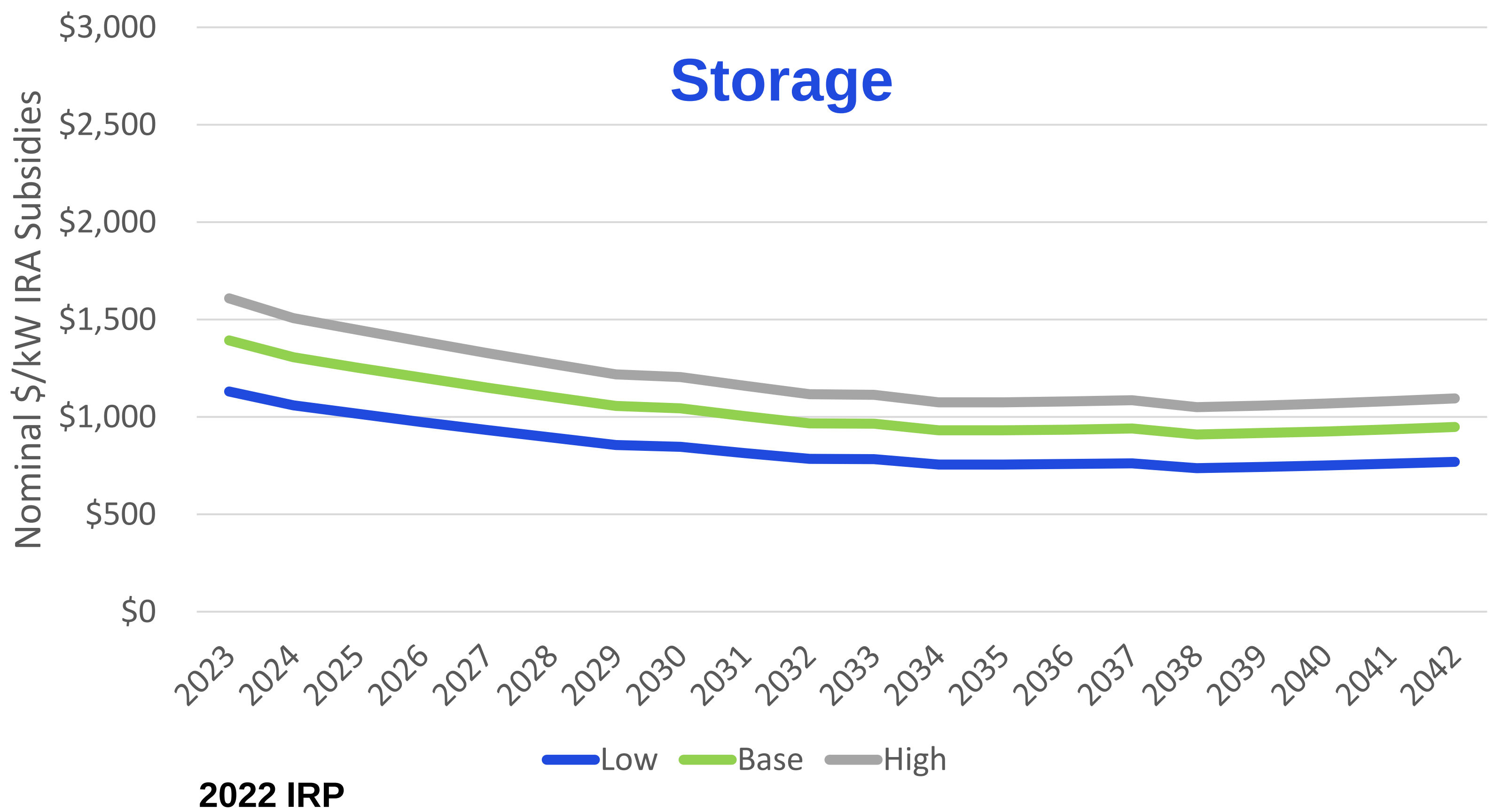
- Using secondary data sources and the responses from AES Indiana's past two RFPs that were issued in 2020 and the spring of 2022, the IRP team created low, base and high levels of renewable resource capital costs.
  - Low – low costs were based on the avg of the 2021 replacement resource capital cost forecasts from Wood Mackenzie, NREL and BNEF and benchmarked against the responses from AES Indiana's 2020 RFP.
  - Base – base costs were based on the lower half of the 2022 all-source RFP responses.
  - High – high costs were based on the upper half of the 2022 all-source RFP responses.
  - **The Renewable Resource Capital Cost Sensitivity analysis was performed by using the high and low cost calculations to increase and decrease the capital costs for the renewable additions in the Candidate Portfolios.**

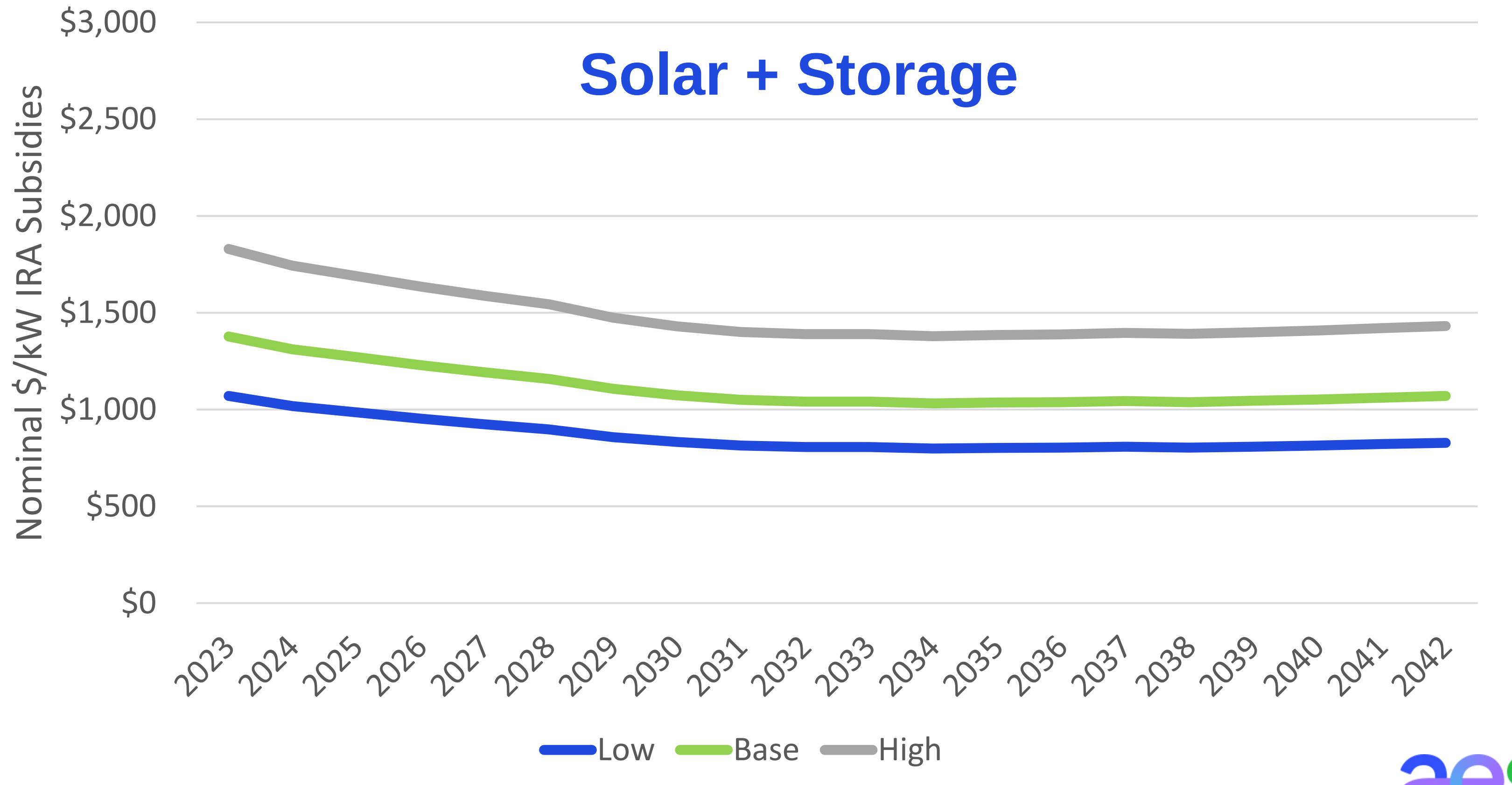
Risk & Opportunity Metrics:

Renewable Resource Capital Costs – Low, Base & High









Risk & Opportunity Metrics:

Renewable Resource Capital Cost Sensitivity Analysis Results

Portfolios with the highest renewable investment are most sensitive to price fluctuations.

****RESULTS****

	Current Trends *(Reference Case)*		
	Low	**Base**	**High**
No Early Retirement	$9,080	$9,572	$10,157
Pete Refuel to 100% Gas (est. 2025)	$8,763	$9,330	$9,999
One Pete Unit Retires (2026)	$9,244	$9,773	$10,406
Both Pete Units Retire (2026 & 2028)	$9,104	$9,618	$10,249
Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)	$9,017	$9,711	$10,442
Encompass Optimization without predefined Strategy (Refuel 2025 & 2027)	$8,730	$9,262	$9,909

Opportunity Metric: Candidate Portfolios using low costs for renewables

Risk Metric: Candidate Portfolios using high costs for renewables

Break for Lunch

Time	Topic	Speakers
Break **12:00 PM – 12:30 PM**	Lunch	
Afternoon **Starting at 12:30 PM**	Reliability, Stability & Resiliency Metric	Hisham Othman, Manager, Resource Planning, Quanta Technology
	IRP Scorecard Results	Erik Miller, Manager, Resource Planning, AES Indiana
	Preferred Resource Portfolio & Short-Term Action Plan	Erik Miller, Manager, Resource Planning, AES Indiana
	Final Q&A and Next Steps	

Reliability, Resiliency & Stability Metric

Hisham Othman, VP Transmission & Regulatory Consulting, Quanta

Integrated Resource Plan (IRP) 2022

Reliability Analysis of IRP Portfolios: Final Report

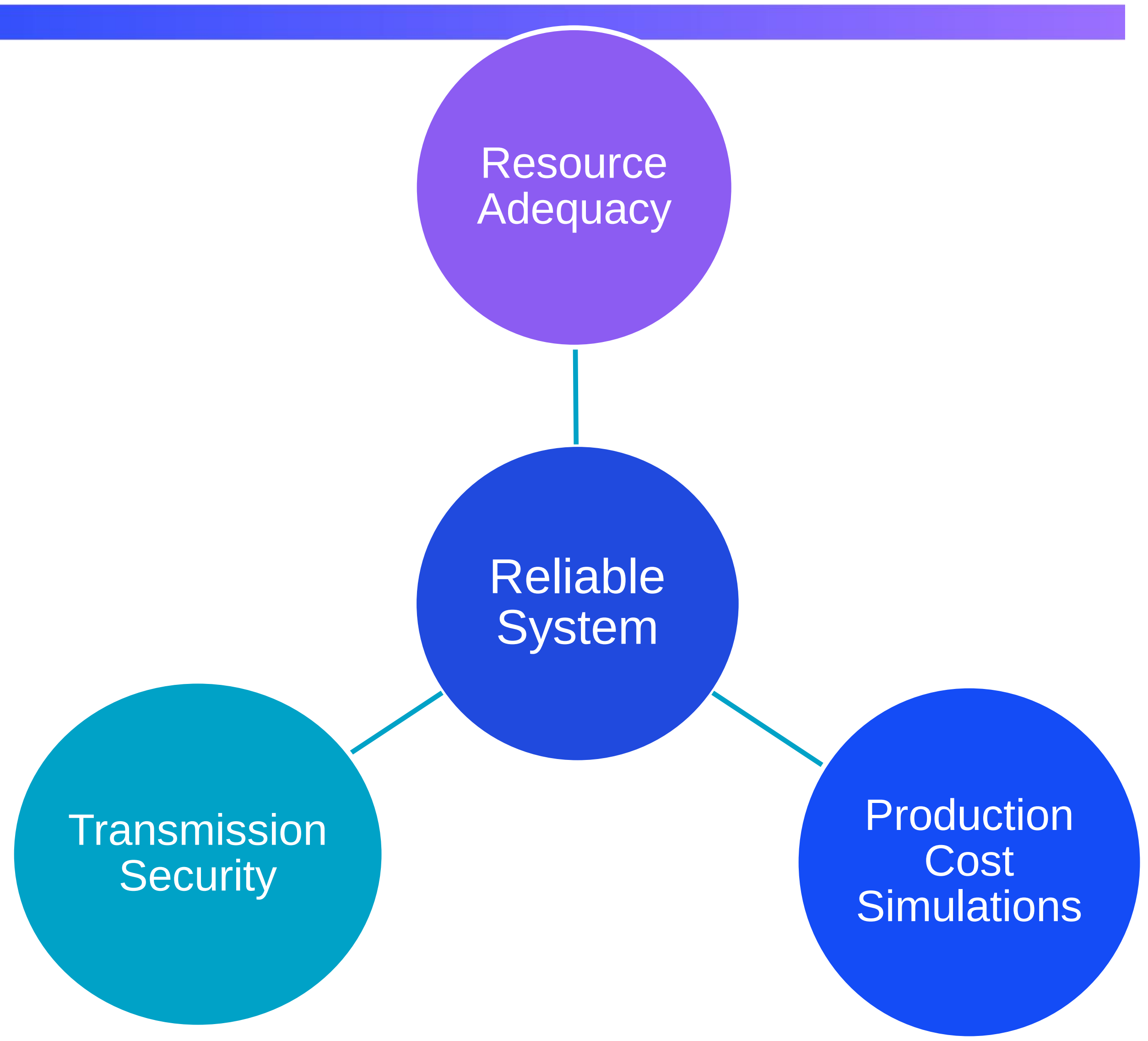
October 19, 2022

Presented by IRP Partner

QUANTA TECHNOLOGY

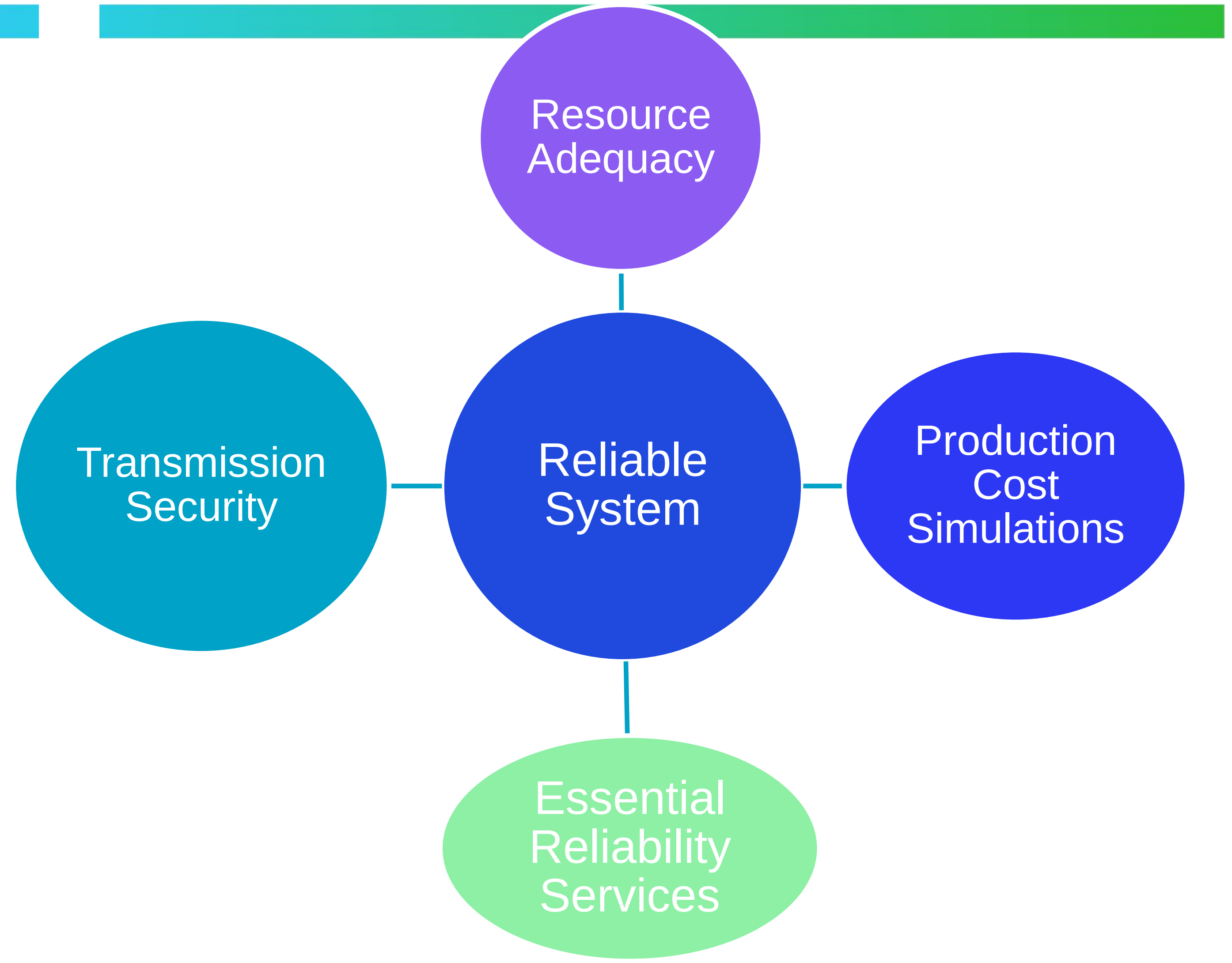
aes Indiana

Managing System Reliability – High IBR Portfolios



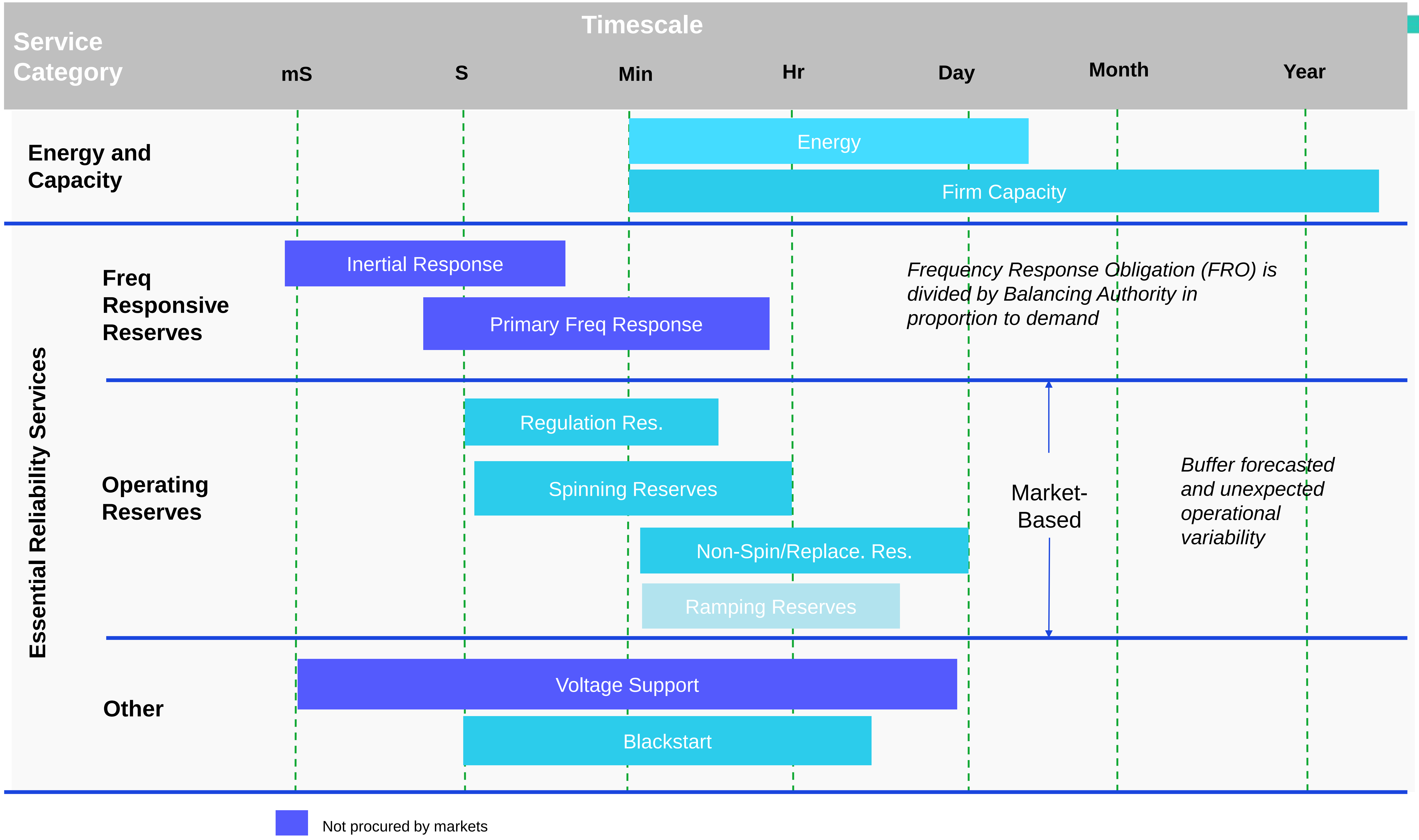
- Traditional planning ensures the provision of sufficient generation and transmission capacity based on:
  - Centralized synchronous generation
  - Dispatchable resources
  - Predictable flow patterns
  - Excludes fuel constraints
  - Few operating snapshots (e.g., 2-4)
  - Separate T and D planning

With increasing retirements and dependence on solar/wind/storage resources, both distributed and utility-scale, planning paradigm is evolving to assure operational reliability.



- Traditional planning methods are evolving:
  - Resource Adequacy: Effective Load Carrying Capability (ELCC)
  - Time-series transmission security (8760 hrs)
  - Probabilistic production cost simulations (renewable/load profiles)
  - Coordinated/Integrated T&D planning
  - Scenario planning approaches to address increased uncertainty
- More analysis is required - Essential Reliability Service

Essential Reliability Services



- Market-Procured Reliability Services
  - Some reliability services are typically procured competitively by the RTO or the ISO such as capacity, energy, and reserves.
- Portfolio-Supplied Reliability Services
  - Some reliability services are assumed to be innately supplied by the resource portfolio such as inertial and primary frequency response and voltage support

Essential Reliability Studies

	Reliability Study Area	Normal (50/50, Connected)	Max-Gen (90/10, Import Limited)	Islanded (Critical Load)
-	Resource Adequacy	X (also 90/10)		
-	Energy Adequacy	X (8760)		
-	Transmission Reliability / Deliverability / Interconnections	X		
1	Energy Adequacy	X	X	X
2	Operational Flexibility and Frequency Support	X		X
3	Short Circuit Strength Requirement	X		X
4	Power Quality (Flicker)	X		X
5	Blackstart			X
6	Dynamic VAR Deliverability	X		
7	Dispatchability and Automatic Generation Control	X		
8	Predictability and Firmness of Supply	X		
9	Geographic Location Relative to Load	X		

Typically, Part of IRP Portfolio Design

Additional Reliability Analysis

Reliability Metrics (1/2)

	Metric	Description	Rationale
1	**Energy Adequacy**	Resources are able to meet the energy and capacity duration requirements. Portfolio resources are able to supply the energy demand of customers during normal and emergency max gen events, and also to supply the energy needs of critical loads during islanded operation events.	Utility must have long duration resources to serve the needs of its customers during emergency and islanded operation events.
2	**Operational Flexibility and Frequency Support**	Ability to provide inertial energy reservoir or a sink to stabilize the system. Additionally, resources can adjust their output to provide frequency support or stabilization in response to frequency deviations with a droop of 5% or better.	Regional markets and/or control centers balance supply and demand under different time frames according to prevailing market construct under normal conditions, but preferable that local control centers possess the ability to maintain operation during under-frequency conditions in emergencies.
3	**Short Circuit Strength Requirement**	Ensure the strength of the system to enable the stable integration of all inverter-based resources (IBRs) within a portfolio.	The retirement of synchronous generators within utility footprint and replacements with increasing levels of inverter-based resources will lower the short circuit strength of the system. Resources than can operate at lower levels of short circuit ratio (SCR) and those that provide higher short circuit current provide a better future proofing without the need for expensive mitigation measures.
4	**Power Quality (Flicker)**	The “stiffness of the grid” affect the sensitivity of grid voltages to the intermittency of renewable resources. Ensuring the grid can deliver power quality in accordance with IEEE standards is essential.	Retirement of large thermal generation plants lower the strength of the grid and increases its susceptibility to voltage flicker due to intermittency of renewable resources, unless properly assessed and mitigated.
5	**Blackstart**	Ensure that resources have the ability to be started without support from the wider system or are designed to remain energized without connection to the remainder of the system, with the ability to energize a bus, supply real and reactive power, frequency and voltage control	In the event of a black out condition, utility must have a blackstart plan to restore its local electric system. The plan should demonstrate the ability to energize a cranking path to start large flexible resources with sufficient energy reservoir.
6	**Dynamic VAR Support**	Customer equipment driven by induction motors (e.g., air conditioning or factories) requires dynamic reactive power after a grid fault to avoid stalling. The ability of portfolio resources to provide this service depends on their closeness to the load centers.	Utility must retain resources electrically close to load centers to provide this attribute in accordance with NERC and IEEE Standards

Reliability Metrics (2/2)

	Metric	Description	Rationale
7	**Dispatchability and Automatic Generation Control**	Resources should respond to directives from system operators regarding their status, output, and timing. Resources that can be ramped up and down automatically to respond immediately to changes in the system contribute more to reliability than resources which can be ramped only up or only down, and those in turn are better than ones that cannot be ramped.	Ability to control frequency is paramount to stability of the electric system and the quality of power delivered to customers. Control centers (regional or local) provide dispatch signals under normal conditions, and under emergency restoration procedures or other operational considerations.
8	**Predictability and Firmness of Supply**	Ability to predict/forecast the output of resources and to counteract forecast errors.	The ability to predict resource output from a day-ahead to real-time is advantageous to minimize the need for spinning reserves. In places with an active energy market, energy is scheduled with the market in the day-ahead hourly market and in the real-time 5-minute market. Deviations from these schedules have financial consequences and thus the ability to accurately forecast the output of a resource up to 38 hours ahead of time for the day-ahead market and 30 minutes for the real time market is advantageous.
9	**Geographic Location Relative to Load (Resilience)**	Ensure the ability to have redundant power evacuation or deliverability paths from resources. Preferrable to locate resources at substations with easy access to multiple high voltage paths, unrestricted fuel supply infrastructure, and close to major load centers.	Location provides economic value in the form of reduced losses, congestion, curtailment risk, and address local capacity requirements. Additionally, from a reliability perspective, resources that are interconnected to buses with multiple power evacuation paths and those close to load centers are more resilient to transmission system outages and provide better assistance in the blackstart restoration process.

Scoring Criteria Thresholds (1/2)

	Year 2031		1 (Pass)	2 (Caution)	3 (Problem)	Rationale
1	Energy Adequacy	Loss of Load Hours (LOLH) - normal system, 50/50 forecast	<2.4 hrs	2.4-4.8 hrs	>4.8 hrs	Expected number of hours in a year the portfolio is energy short and relies on imports (2.4hrs = 1day in 10 years)
		Expected Energy not Served (GWh) - normal system 50/50 fcst	<2.4*Peak	2.4-4.8*Peak	>4.8*Peak	The energy consumption which is not supplied due to insufficient capacity resources within portfolio to meet the demand
		max MW Short (MW) - normal system 50/50 forecast	<90%	90-110%	>110%	The maximum hourly power shortage in the portfolio that has to be supplied by imports (% of Tie-line Import Limits)
		max MW Short - loss of 50% of tieline capacity, 50/50 fcst	<45%	45-55%	>55%	The energy consumption which is not supplied due to insufficient resources and imports to meet the demand, when tieline import capacity is halved
		max MW Short (islanded, 50/50 forecast)	<70%	70-85%	>85%	Ability of Resources to serve critical loads, estimated at 15% of total load. Adding other important loads brings the total to 30%
		max MW Short (normal system, 90/10 forecast)	<5%	5-20%	>20%	Ability of portfolio resources to serve unanticipated growth in load consumption during MISO emergency max-gen events
2	Operational Flexibility and Frequency Support	Inertia MVA-s	>4.2 *Peak	2.6-4.2 *Peak	<2.6 *Peak	Synchronous machine has inertia of 2-5xMVA rating. Conventional systems have inertia that exceeds 2-5x (Peak load x 1.3)
		Inertial Gap FFR MW (% CAP)	0	0-10% of CAP	>10% of CAP	System should have enough inertial response, so gap should be 0. Inertial response of synch machine ≈ 10% of CAP
		Primary Gap PFR MW (% CAP)	0	0-2% of CAP	>2% of CAP	System should have enough primary response, so gap should be 0. Primary response of synch machine ≈ 3.3%of CAP/0.1Hz (Droop 5%)
3	Short Circuit Strength	Inverter MWs passing ESCR limits (%) - Connected System	95%	80-95%	80%	Grid following inverters require short circuit strength at the point of connection to operate properly (ESCR threshold of 3.5)
		Inverter MWs passing ESCR limits (%) - Islanded System	80%	50-80%	>50%	Grid following inverters require short circuit strength at the point of connection to operate properly (ESCR threshold of 3.5)
		Required Additional Synch Condensers MVA (% peak load) - Connected	0	0-500	>500	Portfolio should not require additional synchronous condensers. 500MVArs is a threshold
		Required Additional Synch Condensers MVA (% peak load) - Islanded	0	0-500	>500	Portfolio should not require additional synchronous condensers. 500MVArs is a threshold

Scoring Criteria Thresholds (2/2)

	Year 2031		1 (Pass)	2 (Caution)	3 (Problem)	Rationale
4	Flicker	Compliance with Flicker limits when Connected (GE Flicker Curve or IEC Flicker Meter)	>95%	80-95%	<80%	% of system load buses that is likely to experience flicker (>100% of Border line of irritation or Pst>1)
		Compliance with Flicker limits when Islanded	>80%	50-80%	<50%	% of system load buses that is likely to experience flicker (>100% of Border line of irritation or Pst>1)
		Required Synchronous Condensers MVA to mitigate Flicker	0%	0-500	>500	Size of Synchronous condensers required to mitigate flicker (500MVArs is a threshold)
5	Blackstart	Qualitative Assessment of Ability to Blackstart the system	Excellent	Average	Poor	System requires real and reactive power sources with sufficient rating and duration to start other resources. Higher rated resources lower the risk
6	Dynamic VAR Support	Dynamic VAR to load Center Capability (% of Peak Load)	≥85%	55-85%	<55%	Dynamic reactive power (DRP) should exceed 55-85% of the peak load served by the load centers. DRP requirement to prevent induction motor stalling is 2.5x the steady state reactive consumption. Assuming a PF=0.9, and Induction motors account for 50-80% of the load. Assume that only 20% of the load can experience a common voltage event.
7	Dispatchability	Dispatchable (%CAP)	>60%	50-60%	<50%	Dispatchable resource are essential for system operation
		Unavoidable VER Penetration %	<60%	60-70%	>70%	Intermittent Power Penetration above 60% is problematic when islanded
		Increased Freq Regulation Requirements (% Peak Load)	<2% of peak load	2-3% of Peak Load	>3% of peak load	Regulation of Conventional Systems ≈1%
		1-min Ramp Capability (MW)	>15% of CAP	10-15% of CAP	<10% of CAP	10% per minute was the norm for conventional systems. Renewable portfolios require more ramping capability
		10-min Ramp Capability (MW)	>65% of CAP	50-65% of CAP	<50% of CAP	10% per minute was the norm for conventional systems. But with 50% min loading, that will be 50% in 10 min. Renewable portfolios require more ramping capability
8	Predictability and Firmness	Ramping Capability to Mitigate Forecast Errors (+Excess/-Deficit) (%VER MW)	≥ 0	-10% - 0% of CAP	<-10% of CAP	Excess ramping capability to offset higher levels of intermittent resource output variability is desired
9	Location	Average Number of Evacuation Paths	>3	2-3	<2	More power evacuation paths increase system resilience

Scorecard – Portfolio Scores

			Candidate Portfolios in 2031					
	Year 2031		Status Quo	Refuel	1 Retire	2 Retire	Clean	Optimize
1	Energy Adequacy	Loss of Load Hours (LOLH) - normal system, 50/50 forecast	1	1	0	0	0	1
		Expected Energy not Served (GWh) - normal system 50/50 fcst	1	1	1	1	1	1
		max MW Short (MW) - normal system 50/50 forecast	1	1	1	1	1	1
		max MW Short - loss of 50% of tieline capacity, 50/50 fcst	1	1	1	1/2	0	1
		max MW Short (islanded, 50/50 forecast)	1	1	1	1	1	1
		max MW Short (normal system, 90/10 forecast)	1/2	1/2	0	0	0	1/2
2	Operational Flexibility and Frequency Support	Inertia MVA-s	1/2	1/2	1/2	1/2	1/2	1/2
		Inertial Gap FFR MW (% CAP)	1/2	1/2	1/2	1/2	1/2	1/2
		Primary Gap PFR MW (% CAP)	0	0	1	1	1	0
3	Short Circuit Strength	Inverter MWs passing ESCR limits (%) - Connected System	1	1	1	1	1	1
		Inverter MWs passing ESCR limits (%) - Islanded System	1	1	0	1/2	0	1
		Required Additional Synch Condensers MVA (when Connected)	1	1	1	1	1	1
		Required Additional Synch Condensers MVA (when Islanded)	1	1	1/2	1/2	0	1
4	Power Quality	Compliance with Flicker limits when Connected (GE Flicker Curve or IEC Flicker Meter)	1	1	1	1	1	1
		Compliance with Flicker limits when Islanded	1	1	1	1	1	1
		Required Synchronous Condensers MVA to mitigate Flicker	1	1	1	1	1	1
5	Blackstart	Qualitative Assessment of Ability to Blackstart the system	1	1	1	1	1	1
6	Dynamic VAR Support	Dynamic VAR to load Center Capability (% of Peak Load)	1	1	1	1	1	1
7	Dispatchability and Automatic Generation Control	Dispatchable (%CAP)	1	1	1	1	1	1
		Unavoidable VER Penetration %	1	1	1	1	1	1
		Increased Freq Regulation Requirements (% Peak Load)	1	1	1	1	1	1
		1-min Ramp Capability (MW)	1/2	1/2	1	1	1	1/2
		10-min Ramp Capability (MW)	0	0	1/2	1/2	1/2	0
8	Predictability and Firmness	Ramping Capability to Mitigate Forecast Errors (+Excess/-Deficit) (%VER MW)	1	1	1	1	1	1
9	Location	Average Number of Evacuation Paths	1	1	1	1	1	1

Cumulative score (out of possible 9)	7.95	7.95	7.86	7.90	7.57	7.95

Mitigations

	Current Trends					
	Status Quo	Refuel	1 Retire	2 Retire	Clean	Optimize
Equip Stand-alone ESS with GFM inverters (MW)	**129**	**99**	**183**	**49**	**128**	**98**
Additional Synchronous Condensers (MVA)	**0**	**0**	**350**	**300**	**1500**	**0**
Additional Power Mitigations (MW)	**298**	**326**	**183**	**49**	**128**	**325**
Increased Freq Regulation	39	48	49	45	66	47
Address Inertial Response Gaps	129	99	183	49	128	98
Address Primary Response Gaps	298	326	0	0	0	325
Firm up Intermittent Renewable Forecast	0	0	0	0	0	0

Thank you!

Quanta Technology, LLC (HQ)

4020 Westchase Blvd., Suite 300
Raleigh, NC 27607

Quanta Technology, LLC

905 Calle Amanecer, Suite 200
San Clemente, CA 92673

Quanta Technology, LLC

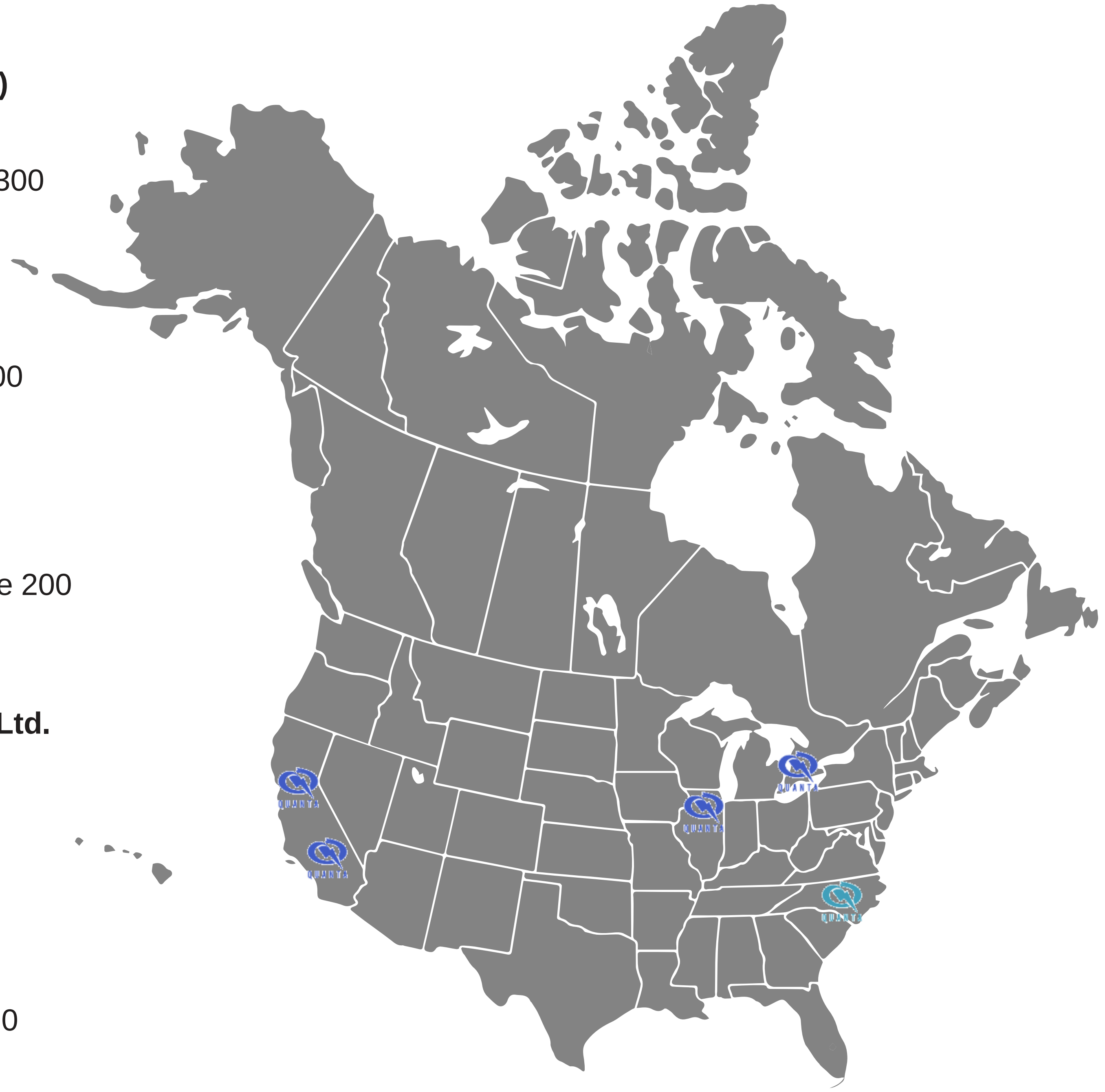
720 East Butterfield Rd., Suite 200
Lombard, IL 60148

Quanta Technology Canada, Ltd.

2900 John Street, Unit 3
Markham, Ontario, L3R 5G3

Quanta Technology, LLC

2300 Clayton Road, Suite 970
Concord, CA 94520



(919) 334-3000

Quanta-Technology.com

Info@Quanta-Technology.com

LinkedIn.com/company/quanta-technology

Hisham Othman
HOthman@Quanta-Technology.com
(919) 000-0000

IRP Scorecard Results

Erik Miller, Manager, Resource Planning, AES Indiana

What is a Preferred Resource Portfolio?

What is a preferred resource portfolio?

"'Preferred resource portfolio' means the utility's selected long term supply-side and demand-side resource mix that safely, reliably, efficiently, and cost-effectively meets the electric system demand, taking cost, risk, and uncertainty into consideration."
IAC 4-7-1-1-cc

Integrated Resource Plan (IRP) in Indiana –> 170 IAC 4-7-2

- 20-year look at how AES Indiana will serve load
- Submitted every three years
- Plan created with stakeholder input
- Modeling and analysis culminates in a preferred resource portfolio and a short-term action plan

Stakeholders are critical to the process

AES Indiana has been committed to providing an engaging and collaborative IRP process for its stakeholders:

- Five Public Advisory Meetings for stakeholders to engage throughout the process
- Five Technical Meetings available to stakeholders with nondisclosure agreements (NDA) for deeper analytics discussion
- Additional ad hoc meetings to review comments and questions from stakeholders with NDAs
- Planning documents and modeling materials were shared with stakeholders with NDAs including Encompass model database
- The Preferred Resource Portfolio was determined after full consideration of stakeholder input

IRP rules link: http://iac.iga.in.gov/iac/iac_title?iact=170&iaca=&submit=+Go Article 4. 170 IAC 4-7-2

aes Indiana

Final IRP Scorecard Results

	Affordability	Environmental Sustainability						Reliability, Stability & Resiliency	Risk & Opportunity							Economic Impact	
	20-yr PVRR	***CO_2 Emissions***	***SO_2 Emissions***	***NO_X Emissions***	***Water Use***	***Coal Combustion Products (CCP)***	***Clean Energy Progress***	***Reliability Score***	***Environmental Policy Opportunity***	***Environmental Policy Risk***	***General Cost Opportunity **Stochastic Analysis*****	***General Cost Risk **Stochastic Analysis*****	***Market Exposure***	***Renewable Capital Cost Opportunity (Low Cost)***	***Renewable Capital Cost Risk (High Cost)***	***Generation Employees (+/-)***	***Property Taxes***
	Present Value of Revenue Requirements ($000,000)	Total portfolio CO2 Emissions (mmtons)	Total portfolio SO2 Emissions (tons)	Total portfolio NOx Emissions (tons)	Water Use (mmgal)	CCP (tons)	% Renewable Energy in 2032	Composite score from Reliability Analysis	Lowest PVRR across policy scenarios ($000,000)	Highest PVRR across policy scenarios ($000,000)	P5 [Mean - P5]	P95 [P95 – Mean]	20-year avg sales + purchases (GWh)	Portfolio PVRR w/ low renewable cost ($000,000)	Portfolio PVRR w/ high renewable cost ($000,000)	Total change in FTEs associated with generation 2023 - 2042	Total amount of property tax paid from AES IN assets ($000,000)
1	$ 9,572	101.9	64,991	45,605	36.7	6,611	45%	7.95	$ 8,860	$ 11,259	$ 9,271 [-$264]	$ 9,840 [$305]	5,291	$ 9,080	$ 10,157	222	$ 154
2	$ 9,330	72.5	13,513	22,146	7.9	1,417	55%	7.95	$ 8,564	$ 11,329	$ 9,030 [-$334]	$ 9,746 [$382]	5,222	$ 8,763	$ 9,999	99	$ 193
3	$ 9,773	88.1	45,544	42,042	26.7	4,813	52%	7.86	$ 9,288	$ 11,462	$ 9,608 [-$294]	$ 10,237 [$336]	5,737	$ 9,244	$ 10,406	195	$ 204
4	$ 9,618	79.5	25,649	24,932	15.0	2,700	48%	7.90	$ 9,135	$ 11,392	$ 9,295 [-$287]	$ 9,903 [$321]	5,512	$ 9,104	$ 10,249	74	$ 242
5	$ 9,711	69.8	25,383	24,881	14.8	2,676	64%	7.57	$ 9,590	$ 11,275	$ 9,447 [-$280]	$ 10,039 [$312]	6,088	$ 9,017	$ 10,442	55	$ 256
6	$ 9,262	76.1	18,622	25,645	10.9	1,970	54%	7.95	$ 8,517	$ 11,226	$ 8,952 [-$324]	$ 9,629 [$352]	5,136	$ 8,730	$ 9,909	88	$ 185

Strategies

- **1.** No Early Retirement
- **2.** Pete Refuel to 100% Natural Gas (est. 2025)
- **3.** One Pete Unit Retires in 2026
- **4.** Both Pete Units Retire in 2026 & 2028
- **5.** “Clean Energy Strategy” – Both Pete Units Retire and replaced with Renewables in 2026 & 2028
- **6.** Encompass Optimization without Predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027

aes Indiana

Opportunities for our people

CONVERSION

→ Jobs to support the conversion from coal to natural gas

RENEWABLES

→ Jobs to support new renewables added on-site

TRANSMISSION AND DISTRIBUTION

→ Jobs to maintain transmission and distribution

CONSTRUCTION

→ Jobs to build and expand infrastructure

New opportunities and continued economic impact

Preferred Resource Portfolio & Short-Term Action Plan

Erik Miller, Manager, Resource Planning, AES Indiana

Preferred Resource Portfolio

Convert Petersburg Coal Units 3 & 4 to Natural Gas in 2025 and add up to ~1,300 MW of wind, solar and storage by 2027

Affordability

→ Provides the least cost to customers over the 20-year planning horizon by lowering the fixed cost at Petersburg through the economic conversion of the remaining Petersburg units from coal to natural gas.

→ Demonstrates lowest annual PVRR relative to other portfolios over the 20-year planning horizon.

Environmental Sustainability

→ Delivers the quickest exit from coal-fired generation (in 2025) which provides the lowest 20-year AES Indiana generation portfolio emissions for SO2, NOx, water use and coal combustion products, and the second lowest emissions for CO2.

Reliability, Stability & Resiliency

→ Offers1-for-1 replacement dispatchable capacity (UCAP) for Petersburg that economically and effectively delivers in meeting MISO's Seasonal Resource Adequacy Construct.

→ Provides firm unforced capacity when needed which will allow AES Indiana to responsibly and gradually transition to renewable energy resources over the planning horizon.

→ Demonstrates the highest composite reliability score while still delivering significant renewable generation investment.

Preferred Resource Portfolio *(continued)*

Convert Petersburg Coal Units 3 & 4 to Natural Gas in 2025 and add up to ~1,300 MW of wind, solar and storage by 2027

Risk & Opportunity

→ Provides best general performance across risk and opportunity metrics.

Economic Impact

→ Continues to contribute economically to the Petersburg community by leveraging existing infrastructure and maintaining operation of the Petersburg Generating Station as a gas resource and hub for renewable resources.

Preferred Resource Portfolio

Convert Petersburg Coal Units 3 & 4 to Natural Gas in 2025 and build ~1,300 MW of renewables by 2027

Natural Gas

Renewables

RETIREMENTS

Short-Term Action Plan (2023–2027)

2031
- Age-based Retirement
- 198 MW Natural Gas – Harding Street Units ST5 & ST6

2034
- Age-based Retirement
- 420 MW Natural Gas – Harding Street Units ST7

2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2042 2043

REPLACEMENTS

2025
- 240 MW New Battery Energy Storage at Petersburg

2025
- 1,052 MW Natural Gas Conversion – Petersburg Units 3 & 4

2025-2027
- 550 – 1,065 MW of new Wind and Solar

2030-2034
- 450 MW New Solar + Storage

2031-2034
- 300 MW New Wind

2031-2034
- 1,450 MW New Solar

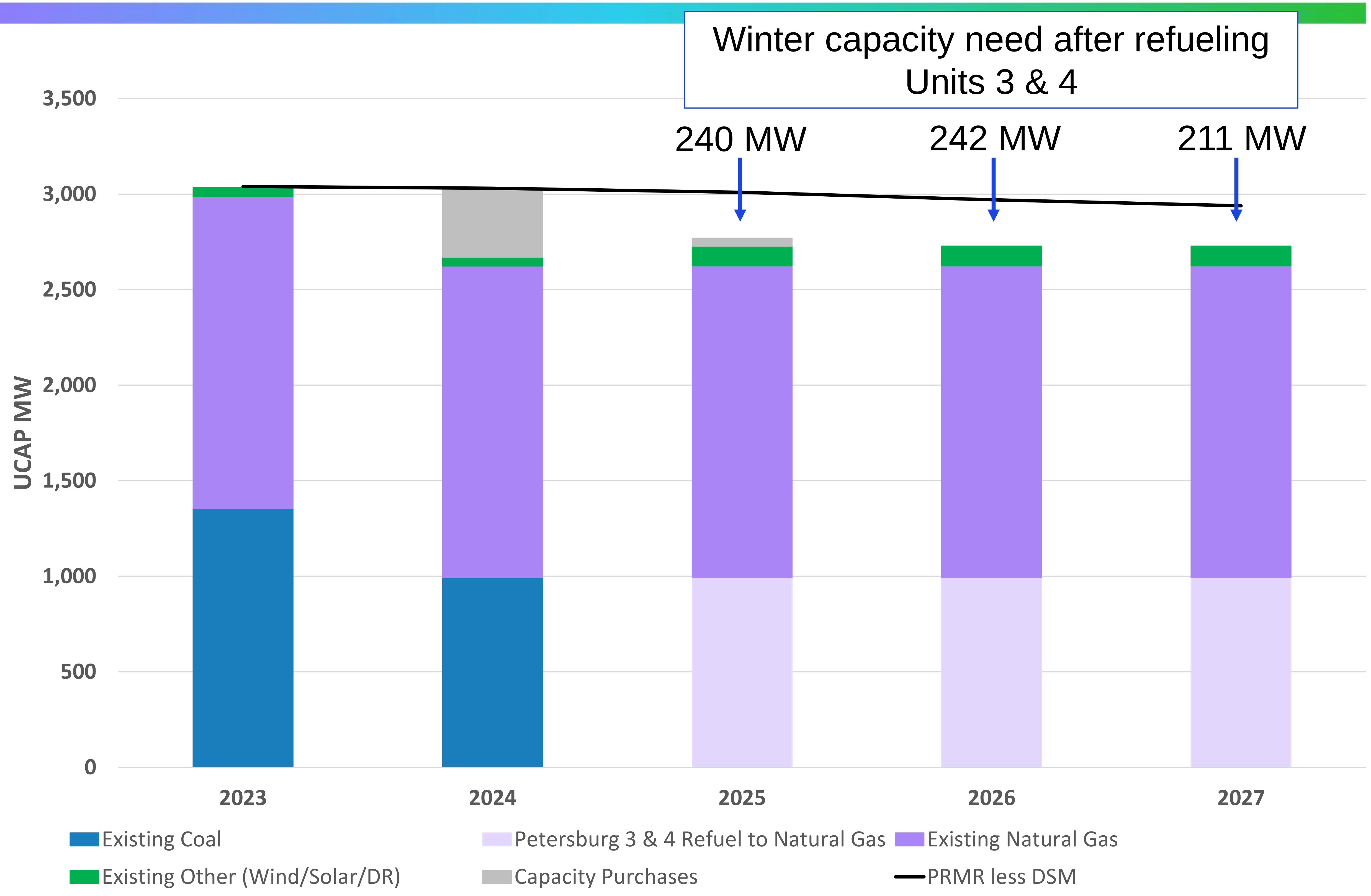
2035-2042
- 1,700 MW New Wind
- 75 MW New Solar
- 110 MW New Solar + Storage

AES Indiana

Winter capacity position after converting Petersburg to Natural Gas

Pete Conversion to 100% Natural Gas (est. 2025)

- Refueling Units 3 & 4 provides 1-for-1 dispatchable replacement of the existing coal units.
- AES Indiana still has a capacity need (~240 MW) in the winter under MISO's new seasonal construct with high winter reserve margin.
- Company to fill the remaining capacity need with renewable generation based on model results.



Short-Term Action Plan: 2023-2027

Convert Petersburg Coal Units 3 & 4 to Natural Gas in 2025 and add up to ~1,300 MW of wind, solar and storage by 2027

AES Indiana's short-term action plan balances reliability, affordability and sustainability by:

- Ceasing coal-fired generation in 2025 after converting Petersburg Units 3 and 4 to natural gas
- Adding up to 1,300 MW of renewable generation for capacity and energy, which includes:
  - 240 MW ICAP of battery energy storage at Petersburg to fill winter capacity position in 2025
  - 550 – 1,065 MW ICAP of wind and solar as energy replacement for Petersburg based on results from the base and low Replacement Resource Capital Cost Sensitivity Analysis
- Implementing three-year DSM action plan that targets an annual average of 130,000 – 134,000 MWh of energy efficiency (approximately 1.1% of 2021 sales) and three-year total of 75 MW summer peak impacts of demand response

Pete Conversion Strategy using **Base** Replacement Resource Costs
(presented in MW ICAP)

Replacements	*2023*	*2024*	*2025*	*2026*	*2027*
Pete Conversion to Natural Gas	0	0	1052	0	0
Wind	0	0	0	50	450
Solar	0	0	0	0	0
Storage	0	0	240	0	0
Solar + Storage	0	0	45	0	0

Pete Conversion Strategy using **Low** Replacement Resource Costs
(presented in MW ICAP)

Replacements	*2023*	*2024*	*2025*	*2026*	*2027*
Pete Conversion to Natural Gas	0	0	1052	0	0
Wind	0	0	0	200	700
Solar	0	0	75	0	0
Storage	0	0	240	0	0
Solar + Storage	0	0	90	0	0

AES Indiana plans to procure a range of renewables as energy replacement for Petersburg based on results from the Base and Low Replacement Resource Capital Cost Sensitivity Analysis. If renewables can be procured at a cost closer to the low-cost sensitivity, then AES Indiana will pursue a quantity consistent with the low sensitivity.

DSM Short Term Action Plan

DSM Results

Energy Efficiency:

	Vintage 1 2024 - 2026	Vintage 2 2027 – 2029	Vintage 3 2030 - 2042
Residential	Efficient Products - Lower Cost	Lower Cost Residential (excluding Income Qualified Weatherization (IQW))	Lower Cost Residential (excluding IQW)
	Efficient Products - Higher Cost		
	Behavioral		
	School Education	Higher Cost Residential (excluding IQW)	Higher Cost Residential (excluding IQW)
	Appliance Recycling		
	Multifamily		
	IQW	IQW	IQW
C&I	Prescriptive	C&I	C&I
	Custom		
	Custom RCx		
	Custom SEM		
Impacts	Avg Annual MWh	Avg Annual MWh	Avg Annual MWh
	131,578 - 134,263	141,526	146,428
	% of 2021 Sales ex. Opt-Out	% of 2021 Sales ex. Opt-Out	% of 2021 Sales ex. Opt-Out
	1 - 1.1%	1.1%	1.2%
	Cumulative Summer MW	Cummulative Summer MW	Cummulative Summer MW
	87 - 89 MW	92 MW	303 MW

Demand Response:

	2026 - 2042
Residential	Direct Load Control
	Residential Rates
C&I	Direct Load Control
	C&I Rates
	Cumulative Summer MW
	75 MW

Note: Boxes highlighted in purple denote DSM bundles that were selected by Encompass

Affordability

Petersburg conversion to natural gas provides the lowest 20-yr PVRR and low PVRR volatility over the planning period

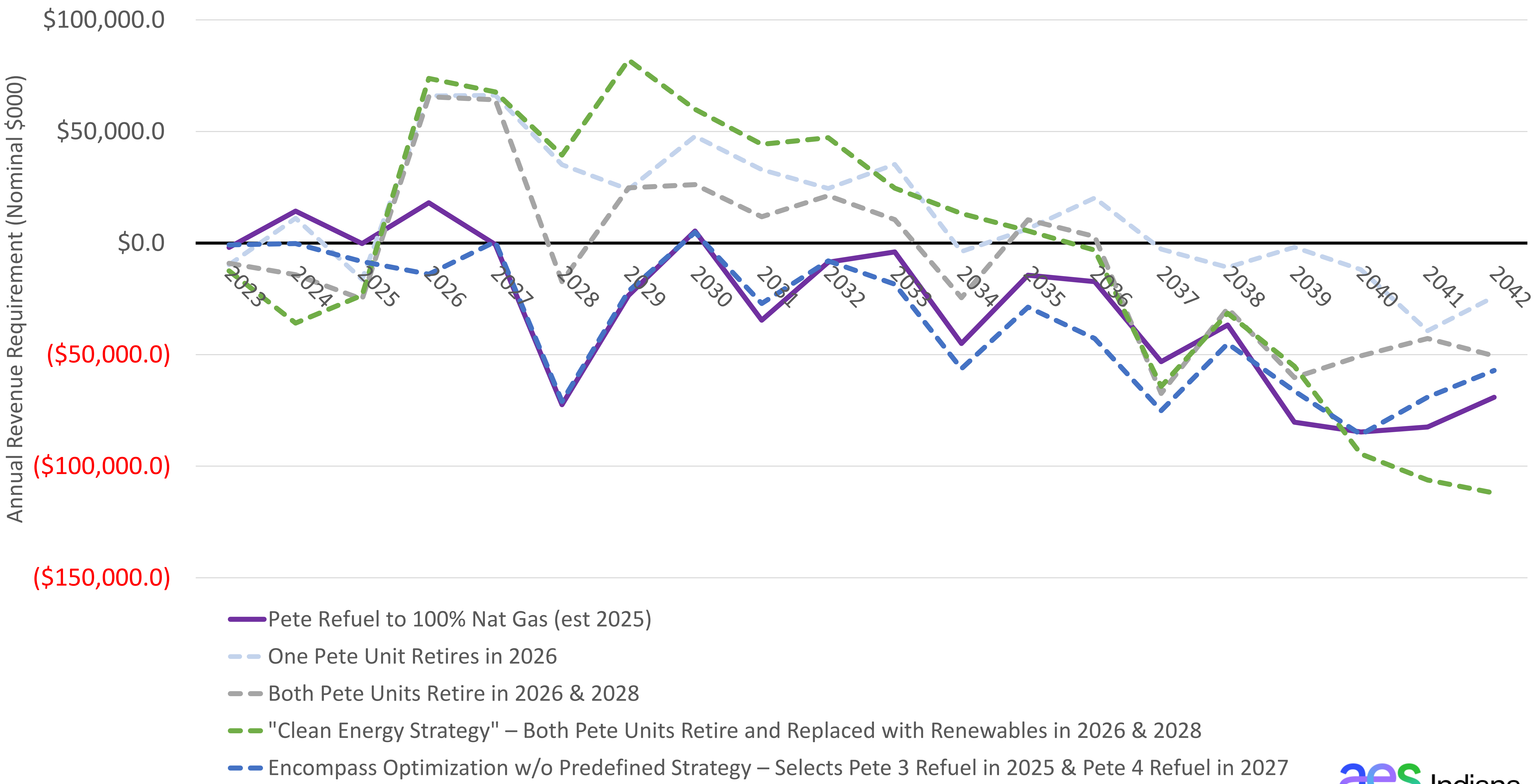
20-yr PVRR

	Present Value of Revenue Requirements (2023 $000,000)
1	$ 9,572
2	$ 9,330
3	$ 9,773
4	$ 9,618
5	$ 9,711
6	$ 9,262

Strategies

- **1.** No Early Retirement
- **2.** Pete Refuel to 100% Natural Gas (est. 2025)
- **3.** One Pete Unit Retires in 2026
- **4.** Both Pete Units Retire in 2026 & 2028
- **5.** “Clean Energy Strategy” – Both Pete Units Retire and replaced with Renewables in 2026 & 2028
- **6.** Encompass Optimization without Predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027

Compared to the No Retirement (“Status Quo”) Scenario

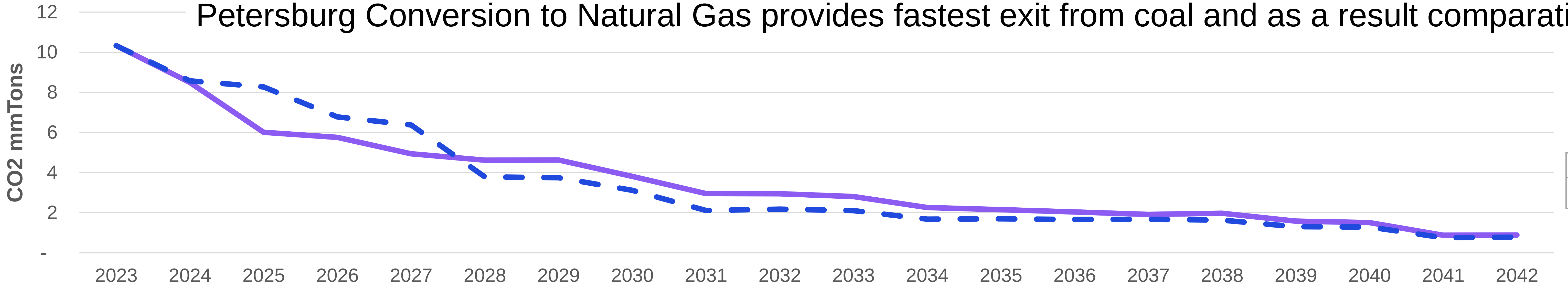


Indiana

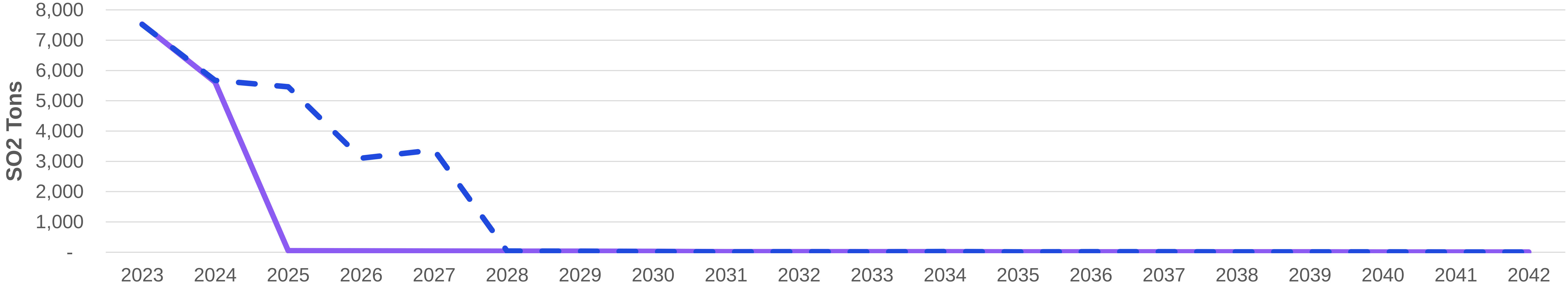
Sustainability

Emissions Comparison – Petersburg Conversion vs Clean Energy Strategy

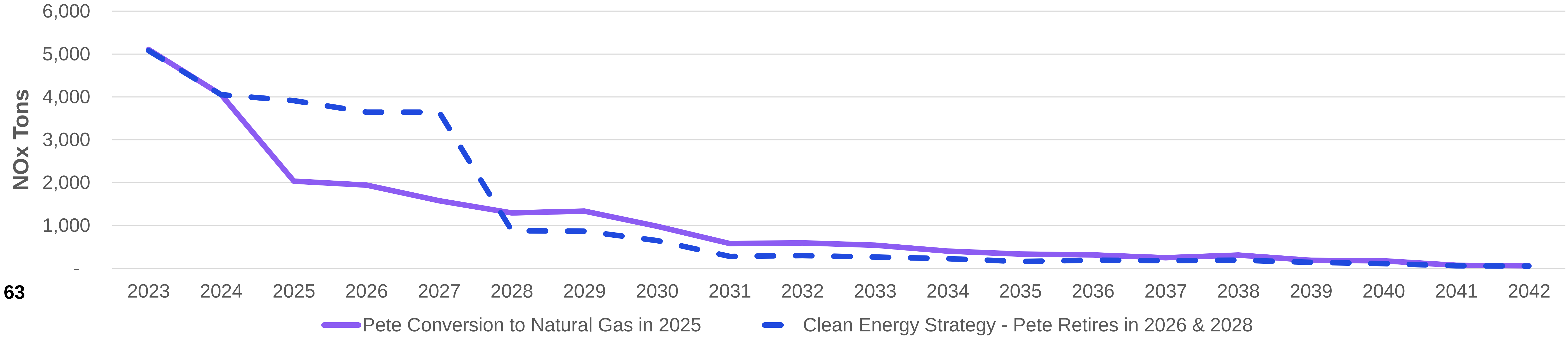
Petersburg Conversion to Natural Gas provides fastest exit from coal and as a result comparatively low emissions



CO2 mmTons	2023 - 2032	2023 - 2042
Pete Conversion	54	73
Clean Energy Strategy	55	70



SO2 Tons	2023 - 2032	2023 - 2042
Pete Conversion	13,402	13,513
Clean Energy Strategy	25,254	25,383

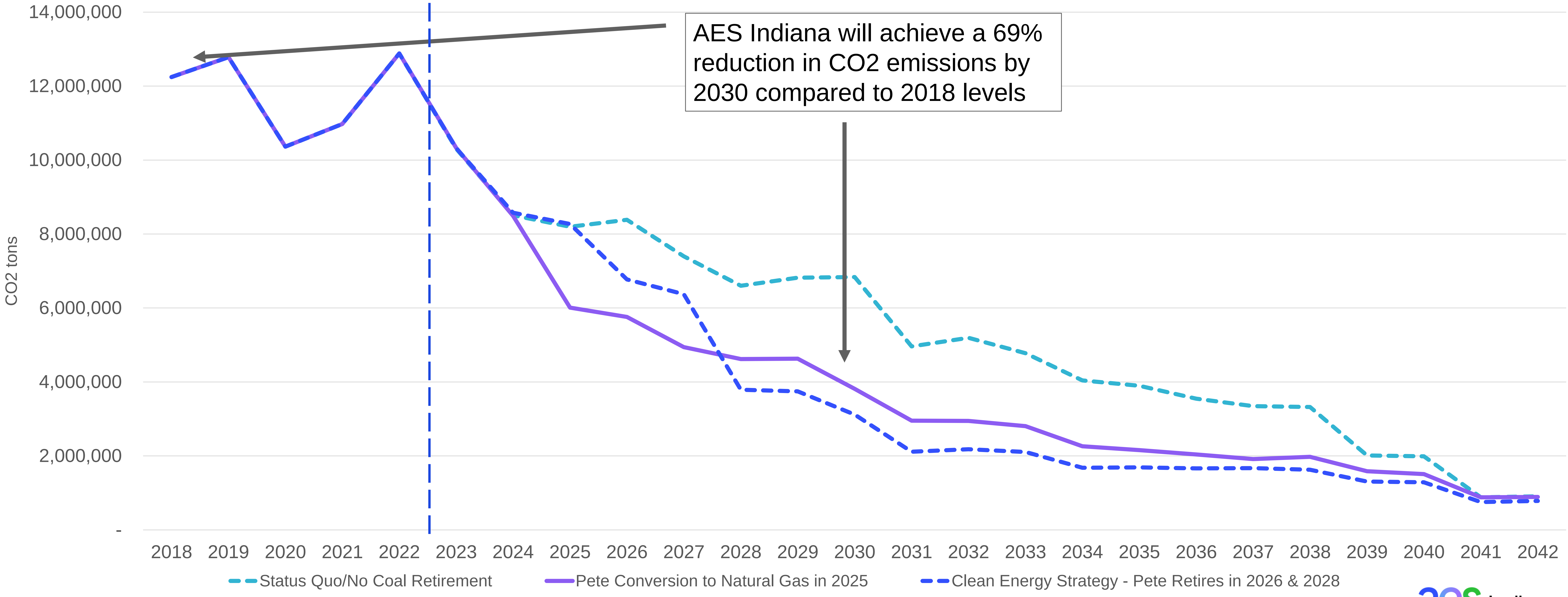


NOx Tons	2023 - 2032	2023 - 2042
Pete Conversion	19,501	22,146
Clean Energy Strategy	23,303	24,881

Sustainability

AES Indiana Generation Portfolio CO2 Emissions Projections

Converting Petersburg Units 3 & 4 to natural gas effectively reduces CO2 emissions due to a low-capacity factor of Pete on natural gas combined with significant investment in renewables.



City of Indianapolis Recommendations for AES Indiana’s 2022 IRP

City of Indianapolis Recommendations	AES Indiana Response
The City of Indianapolis seeks a resource mix with renewable generation capacity that aligns with the goals of the City and community. *City recommends AES Indiana develop a model with multiple scenarios that achieve a 62.8% reduction over 2018 emissions levels, in order to align with the City’s Science Based Target’s for 2030.*	AES Indiana's Preferred Resource Portfolio achieves a 69% reduction in CO_2 emissions in 2030 compared to 2018 levels. The portfolio provides affordable, reliable and sustainable energy to Indianapolis residents.
The City of Indianapolis strongly supports AES Indiana’s use of “all-source” procurement for future capacity additions to ensure cost-effective, market-driven innovation.	AES Indiana will fill it's need for replacement capacity identified in the Short-Term Action Plan through all-source RFPs. The Company will pursue the most cost effective and viable wind, and storage projects through this process.
The City of Indianapolis encourages AES Indiana to expand offerings of and access to energy efficiency programs targeting those with the highest energy burden.	AES Indiana has identified energy efficiency as a cost-effective energy resource and will work to develop a new energy efficiency program plan to start in 2024 - 2026. Based on current IRP modeling results we expect our new plan will continue to have an emphasis on programs that provide energy savings to all customers, with added emphasis on programs that benefit low- and moderate-income households.
The City of Indianapolis encourages AES Indiana to support a Just Transition for each Indiana community.	AES Indiana will continue to invest in new technologies and identify clean energy projects that deliver greener, smarter energy solutions. AES Indiana remains invested in our communities through commitments to the workforce, charitable organizations and economic development. Advanced modeling, additional economic impact metrics, greater transparency with stakeholders and increased accessibility to the IRP process allowed AES Indiana to paint a full picture of the potential impacts of each generation strategy and select a just and inclusive portfolio.
The City of Indianapolis requests that AES Indiana make energy performance and aggregated whole building data available to customers.	AES Indiana currently offers online tools that provide customers throughout our service territory with access to their energy usage data. These tools also provide recommendations to customers for managing their energy usage and costs through energy efficiency measures and programs. As AES Indiana expects the capabilities of our online tools will evolve to support additional customer friendly features that meet current and future data driven needs such as whole building data aggregation.

2022 IRP Key Modeling Solutions

There were several significant events in 2022 that created challenges for IRP modeling.

Market Changes	Modeling Solutions
In 2022, FERC approved MISO's Seasonal Capacity Construct and MISO's Capacity Market cleared at CONE (Planning Reserve Auction – PRA)	Modeled a MISO's Seasonal Capacity Construct and included CONE as the capacity price in all four seasons
Inflated replacement resource capital costs identified through AES Indiana's 2022 RFP	Conducted Replacement Resource Sensitivity Analysis with low, base and high capital costs for replacement resources. Analysis optimized portfolios assuming a range of capital costs. Provides for flexibility in executing the Short-Term Action Plan if resources can be procured at a lower cost
Inflation Reduction Act of 2022 passed into law in August of 2022 which changed the ITC and PTC provisions for renewable resources	Included IRA assumptions in the Current Trends (Reference Case) Scenarios for candidate portfolio evaluation
Scarcity within the NOx allowance market brought on by uncertainty around CSAPR resulted in historically high NOx prices	Increased NOx price forecast in near-term to reflect current NOx allowance market volatility
Volatile commodities starting in early 2022 marked by inflated gas and power prices starting Feb/Mar 2022	Updated commodity curves using ICE Forward Curves from May 31, 2022 and Spring 2022 Horizon Fundamental Curves

Future Modeling Enhancements

2022 IPL IRP

- Focused modeling on viable renewable technologies – wind, solar & storage
- Conducted hourly dispatch modeling to capture portfolio PVRR
- Distribution System Planning analysis that assessed system constraints from emerging technologies
- Captured appropriate resource accreditation for non-dispatchable generation based on MISO guidance

Consideration for Future IRPs

- Model alternative replacement resource options such as hydrogen or SMRs if commercially viable
- Sub hourly modeling to capture additional PVRR benefits including ancillary services value of battery energy storage and reciprocating engines
- Enhanced Distribution System Planning that captures circuit-level value of distributed generation and DSM
- Include refinements made to non-dispatchable resource seasonal capacity credit such as seasonal ELCC

aes Indiana

IRP SURVEY

- AES Indiana invites the public and stakeholders to provide feedback on the IRP process.
- Your responses will help AES Indiana ensure the 2022 IRP reflects a meaningful, objective look at our shared energy future.
- Input from this survey will be reviewed by members of the IRP team in advance of the final IRP report filing on or before Dec. 1, 2022, and to improve future IRPs.
- Your participation in this survey is confidential and completely voluntary.
- Responses will be collected until Nov. 13, 2022.
- The survey link will be shared in the chat.

Final Q&A and Next Steps

Public Advisory Meeting

Public Advisory Meeting #1	Public Advisory Meeting #2	Public Advisory Meeting #3	Public Advisory Meeting #4	Public Advisory Meeting #5
Jan. 24, 2022	**April 12, 2022**	**June 27, 2022**	**Sept. 19, 2022**	**Oct. 31, 2022**

→ All meetings were made available for attendance via Teams.

→ A Technical Meeting was held the week preceding each Public Advisory Meeting for stakeholders with nondisclosure agreements. Tech Meeting topics focused on those anticipated at the proceeding Public Advisory Meeting.

→ Meeting materials can be accessed at ***www.aesindiana.com/integrated-resource-plan.***

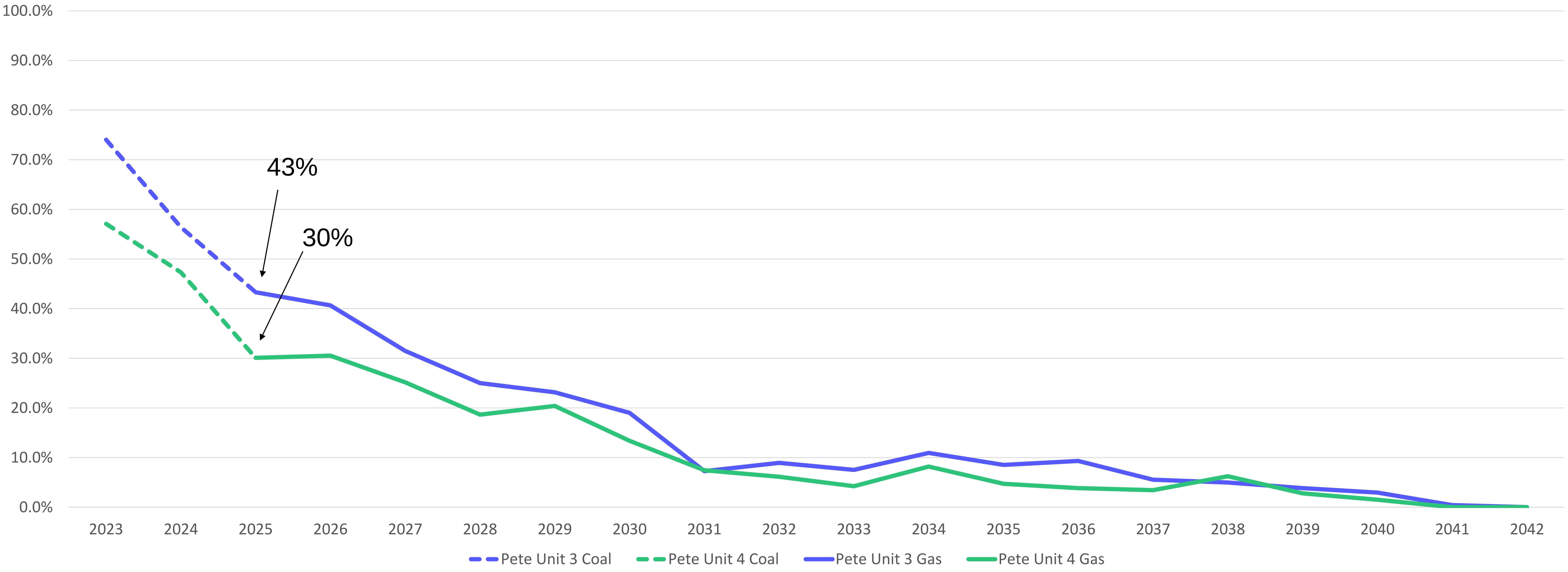
→ ***IRP Report will be filed with the IURC December 1, 2022***

Thank You

Appendix

Petersburg Capacity Factors Pre vs Post Gas Conversion

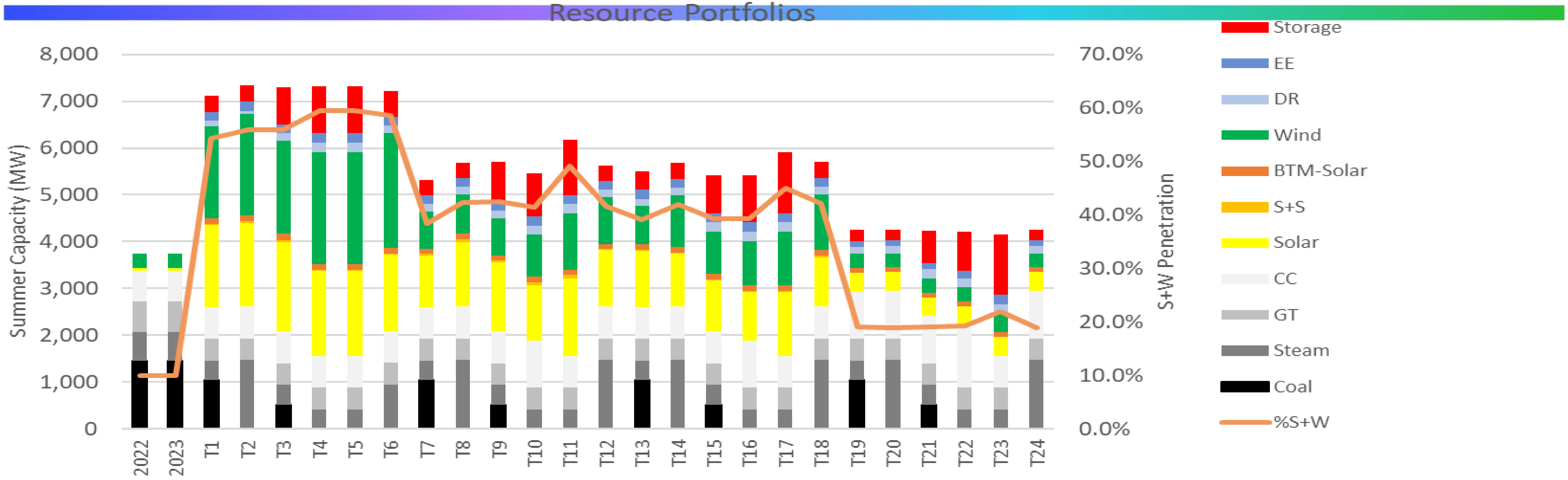
Converting Petersburg to natural gas results in significant drop in capacity factor that continues over the planning period.



Quanta Analysis - Appendix 1

All Portfolios

Portfolios (T1-T24)



	Aggressive Environmental						Current Trends						Decarbonization						No Environmental					
	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz
Disp %	**43**	**42**	**42**	**38**	**38**	**39**	**58**	**55**	**54**	**55**	**48**	**55**	**57**	**55**	**57**	**57**	**52**	**55**	**78**	**78**	**78**	**77**	**73**	**78**
S&W %	54	56	56	59	59	59	38	42	43	41	49	42	39	42	39	39	45	42	19	19	19	19	22	19

Portfolio Resources

	Aggressive Environmental						Current Trends						Decarbonization						No Environmental					
	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz
Y2031 - All Resources	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**T16**	**T17**	**T18**	**T19**	**T20**	**T21**	**T22**	**T23**	**T24**
Solar	1,755	1,780	1,905	1,805	1,805	1,630	1,105	1,380	1,480	1,180	1,655	1,205	1,205	1,130	1,080	1,030	1,355	1,055	405	405	405	405	405	405
BTM-Solar	124	124	124	124	124	124	110	110	110	110	110	110	124	124	124	124	124	124	102	102	102	102	102	102
Wind	1,950	2,150	2,000	2,400	2,400	2,450	800	850	800	900	1,200	1,000	800	1,100	900	950	1,150	1,200	300	300	300	300	400	300
S+S	25	50	50	25	25	25	25	60	35	69	69	25	25	25	25	25	25	25	0	0	0	0	0	0
Storage	333	345	785	1,013	1,013	553	333	313	840	920	1,180	313	393	333	813	1,013	1,293	333	240	240	680	820	1,280	240
Steam	420	1,472	420	420	420	946	420	1,472	420	420	420	1,472	420	1,472	420	420	420	1,472	420	1,472	420	420	420	1,472
GT	464	464	464	464	464	464	464	464	464	464	464	464	464	464	464	464	464	464	464	464	464	464	464	464
CC	680	680	680	680	680	680	680	680	680	1,005	680	680	680	680	680	1,005	680	680	1,005	1,005	1,005	1,330	680	1,005
Coal	1,040	0	520	0	0	0	1,040	0	520	0	0	0	1,040	0	520	0	0	0	1,040	0	520	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EE	195	195	195	195	195	195	195	194	194	194	195	195	195	195	195	195	195	194	118	118	136	165	194	119
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DR	121	73	154	198	198	154	154	154	154	198	198	154	154	154	198	198	198	154	154	154	198	198	198	154
ICAP (MW) - Total	**7,106**	**7,333**	**7,296**	**7,322**	**7,322**	**7,220**	**5,325**	**5,676**	**5,696**	**5,460**	**6,170**	**5,617**	**5,499**	**5,676**	**5,417**	**5,422**	**5,902**	**5,700**	**4,247**	**4,259**	**4,229**	**4,203**	**4,142**	**4,260**
Conventional (MW)	2,604	2,616	2,084	1,564	1,564	2,090	2,604	2,616	2,084	1,889	1,564	2,616	2,604	2,616	2,084	1,889	1,564	2,616	2,929	2,941	2,409	2,214	1,564	2,941
Intermittent (MW)	3,854	4,104	4,079	4,354	4,354	4,229	2,040	2,390	2,415	2,240	3,015	2,340	2,154	2,379	2,129	2,129	2,654	2,404	807	807	807	807	907	807
Storage (MW)	333	345	785	1,013	1,013	553	333	313	840	920	1,180	313	393	333	813	1,013	1,293	333	240	240	680	820	1,280	240
% Renewable Penetration	70%	76%	74%	81%	81%	80%	35%	40%	41%	39%	52%	41%	36%	42%	37%	37%	46%	43%	13%	13%	13%	13%	15%	13%
% Intermittent	54%	56%	56%	59%	59%	59%	38%	42%	43%	41%	49%	42%	39%	42%	39%	39%	45%	42%	19%	19%	19%	19%	22%	19%

Scorecard – Portfolio Scores

			Aggressive Environmental						Current Trends						Decarbonization						No Environmental					
			Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz
	Year 2031		**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**T16**	**T17**	**T18**	**T19**	**T20**	**T21**	**T22**	**T23**	**T24**
1	Energy Adequacy	Loss of Load Hours (LOLH) - normal system, 50/50 forecast	1	1	1	0	0	1	1	1	0	0	0	1	1	1	0	1	0	1	1	1	1	0	0	1
		Expected Energy not Served (GWh) - normal system 50/50 fcst	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		max MW Short (MW) - normal system 50/50 forecast	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		max MW Short - loss of 50% of tieline capacity, 50/50 fcst	1	1	1	0	0	1	1	1	1	1/2	0	1	1	1	1	1	0	1	1	1	1	1	0	1
		max MW Short (islanded, 50/50 forecast)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		max MW Short (normal system, 90/10 forecast)	1/2	1/2	0	0	0	0	1/2	1/2	0	0	0	1/2	1/2	1/2	0	1/2	0	1/2	1/2	1/2	0	0	0	1/2
2	Operational Flexibility and Frequency Support	Inertia MVA-s	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1/2	1	1/2	1
		Inertial Gap FFR MW (% CAP)	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
		Primary Gap PFR MW (% CAP)	0	0	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	0
3	Short Circuit Strength	Inverter MWs passing ESCR limits (%) - Connected System	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Inverter MWs passing ESCR limits (%) - Islanded System	0	0	0	0	0	0	1	1	0	1/2	0	1	1	1	1/2	1/2	0	1	1	1	1	1	1	1
		Required Additional Synch Condensers MVA (when Connected)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Required Additional Synch Condensers MVA (when Islanded)	0	0	0	0	0	0	1	1	1/2	1/2	0	1	1	1	1/2	1/2	0	1	1	1	1	1	1	1
4	Power Quality	Compliance with Flicker limits when Connected (GE Flicker Curve or IEC Flicker Meter)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Compliance with Flicker limits when Islanded	1	1	1	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Required Synchronous Condensers MVA to mitigate Flicker	1	1	1	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	Blackstart	Qualitative Assessment of Ability to Blackstart the system	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	Dynamic VAR Support	Dynamic VAR to load Center Capability (% of Peak Load)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	Dispatchability and Automatic Generation Control	Dispatchable (%CAP)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Unavoidable VER Penetration %	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Increased Freq Regulation Requirements (% Peak Load)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		1-min Ramp Capability (MW)	1/2	1/2	1	1	1	1	1/2	1/2	1	1	1	1/2	1/2	1/2	1	1	1	1/2	1/2	1/2	1	1	1	1/2
		10-min Ramp Capability (MW)	0	0	0	1/2	1/2	0	0	0	1/2	1/2	1/2	0	0	0	1/2	1/2	1	0	0	0	1/2	1/2	1	0
8	Predictability and Firmness	Ramping Capability to Mitigate Forecast Errors (+Excess/-Deficit) (%VER MW)	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	Location	Average Number of Evacuation Paths	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24
1	Energy Adequacy	0.92	0.92	0.83	0.50	0.50	0.83	0.92	0.92	0.67	0.58	0.50	0.92	0.92	0.92	0.67	0.92	0.50	0.92	0.92	0.92	0.83	0.67	0.50	0.92
2	Dispatchability and Automatic Generation Control	0.70	0.70	0.80	0.90	0.90	0.80	0.70	0.70	0.90	0.90	0.90	0.70	0.70	0.70	0.90	0.90	1.00	0.70	0.70	0.70	0.90	0.90	1.00	0.70
3	Operational Flexibility and Frequency Support	0.33	0.33	0.67	0.67	0.67	0.33	0.33	0.33	0.67	0.67	0.67	0.33	0.33	0.33	0.67	0.67	0.67	0.33	0.50	0.50	0.67	0.83	0.67	0.50
4	Predictability and Firmness	0.50	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	Short Circuit Strength	0.50	0.50	0.50	0.50	0.50	0.50	1.00	1.00	0.63	0.75	0.50	1.00	1.00	1.00	0.75	0.75	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	Dynamic VAR Support	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	Location	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	Power Quality	1.00	1.00	1.00	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	Blackstart	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Cumulative Score (out of possible 9)	6.95	6.95	7.80	7.23	7.23	7.47	7.95	7.95	7.86	7.90	7.57	7.95	7.95	7.95	7.98	8.23	7.67	7.95	8.12	8.12	8.40	8.40	8.17	8.12

QUANTA TECHNOLOGY aes Indiana

Mitigations

	Aggressive Environmental						Current Trends						Decarbonization						No Environmental					
	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz	Quo	Refuel	1 Retire	2 Retire	Clean	Optimiz
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**T16**	**T17**	**T18**	**T19**	**T20**	**T21**	**T22**	**T23**	**T24**
Equip Stand-alone ESS with GFM inverters (MW)	**124**	**93**	**178**	**123**	**123**	**164**	**129**	**99**	**183**	**49**	**128**	**98**	**129**	**98**	**183**	**49**	**128**	**98**	**53**	**23**	**107**	**221**	**133**	**23**
Additional Synchronous Condensers (MVA)	**1250**	**1500**	**1900**	**2700**	**2700**	**2050**	**0**	**0**	**350**	**300**	**1500**	**0**	**0**	**0**	**100**	**200**	**1100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Additional Power Mitigations (MW)	**323**	**322**	**178**	**123**	**123**	**164**	**298**	**326**	**183**	**49**	**128**	**325**	**239**	**310**	**183**	**49**	**128**	**310**	**370**	**378**	**107**	**221**	**133**	**378**
Increased Freq Regulation	90	97	97	105	105	101	39	48	49	45	66	47	42	48	41	41	56	49	9	9	9	9	11	9
Address Inertial Response Gaps	124	93	178	123	123	164	129	99	183	49	128	98	129	98	183	49	128	98	53	23	107	221	133	23
Address Primary Response Gaps	323	322	0	0	0	117	298	326	0	0	0	325	239	310	0	0	0	310	370	378	0	0	0	378
Firm up Intermittent Renewable Forecast	94	138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

IRP Acronyms

Note: A glossary of acronyms with definitions is available at https://www.aesindiana.com/integrated-resource-plan.

IRP Acronyms

- ACEE: The American Council for an Energy-Efficient Economy
- AMI: Advanced Metering Infrastructure
- AD: Ad Valorem
- AD/CVD: Antidumping and Countervailing Duties
- ADMS: Advanced Distribution Management System
- BESS: Battery Energy Storage System
- BNEF: Bloomberg New Energy Finance
- BTA: Build-Transfer Agreement
- BTU: British Thermal Unit
- C&I: Commercial and Industrial
- CAA: Clean Air Act
- CAGR: Compound Annual Growth Rate
- CCGT: Combined Cycle Gas Turbines
- CCP: Coal Combustion Products
- CCS: Carbon Dioxide Capture and Storage
- CDD: Cooling Degree Day
- CIS: Customer Integrated System
- COD: Commercial Operation Date
- CONE: Cost of New Entry
- CP: Coincident Peak
- CPCN: Certificate of Public Convenience and Necessity
- CT: Combustion Turbine
- CVD: Countervailing Duties
- CVR: Conservation Voltage Reduction
- DER: Distributed Energy Resource
- DERA: Distributed Energy Resource Aggregation
- DERMS: Distributed Energy Resource Management System
- DG: Distributed Generation
- DGPV: Distributed Generation Photovoltaic System
- DLC: Direct Load Control
- DOC: U.S. Department of Commerce
- DOE: U.S. Department of Energy
- DR: Demand Response
- DRR: Demand Response Resource
- DSM: Demand-Side Management
- DMS: Distribution Management System
- DSP: Distribution System Planning
- EE: Energy Efficiency
- EFORd: Equivalent Forced Outage Rate Demand
- EIA: Energy Information Administration
- ELCC: Effective Load Carrying Capability
- EM&V: Evaluation Measurement and Verification
- ESCR: Effective Short Circuit Ratio
- ESPT: Energy Storage Planning Tool
- EV: Electric Vehicle
- FLOC: Functional Location
- FTE: Full-Time Employee
- GDP: Gross Domestic Product
- GFL: Grid-Following System
- GFM: Grid-Forming System
- GIS: Geographic Information System
- GT: Gas Turbine
- HDD: Heating Degree Day
- HVAC: Heating, Ventilation, and Air Conditioning
- IAC: Indiana Administrative Code
- IBR: Inverter-Based Resource
- IC: Indiana Code
- ICE: Intercontinental Exchange
- ICAP: Installed Capacity

IRP Acronyms

- IEEE: Institute of Electrical and Electronics Engineers
- IRA: Inflation Reduction Act
- IRP: Integrated Resource Plan
- ICE: Internal Combustion Engine
- IQW: Income Qualified Weatherization
- ITC: Investment Tax Credit
- IURC: Indiana Regulatory Commission
- kW: Kilowatt
- kWh: Kilowatt-Hour
- Li-ion: Lithium-ion
- MATS: Mercury and Air Toxics Standards
- MaxGen: Maximum Generation
- MDMS: Meter Data Management System
- MISO: Midcontinent Independent System Operator
- MMGAL: One Million Gallons
- MMTons: One Million Metric Tons
- MPS: Market Potential Study
- MS: Millisecond
- MVA: Mega Volt Ampere
- MW: Megawatt
- Nat Gas: Natural Gas
- NDA: Nondisclosure Agreement
- NOX: Nitrogen Oxides
- NPV: Net Present Value
- NREL: National Renewable Energy Laboratory
- NTG: Net to Gross
- OMS: Outage Management System
- PLL: Phase-Locked Loop
- PPA: Power Purchase Agreement
- PRA: Planning Resource Auction
- PSSE: Power System Simulator for Engineering
- PTC: Renewable Electricity Production Tax Credit
- PRMR: Planning Reserve Margin Requirement
- PV: Photovoltaic
- PVRR: Present Value Revenue Requirement
- PY: Planning Year
- RA: Resource Adequacy
- RAN: Resource Availability and Need
- RAP: Realistic Achievable Potential
- RCx: Retrocommissioning
- REC: Renewable Energy Credit
- REP: Renewable Energy Production
- RFP: Request for Proposals
- RIIA: MISO’s Renewable Integration Impact Assessment
- RPS: Renewable Portfolio Standard
- SCADA: Supervisory Control and Data Acquisition
- RTO: Regional Transmission Organization
- SAC: MISO’s Seasonal Accredited Capacity
- SAE: Small Area Estimation
- SCR: Selective Catalytic Reduction System
- SEM: Strategic Energy Management
- SO2: Sulfur Dioxide
- SMR: Small Modular Reactors
- ST: Steam Turbine
- SUFG: State Utility Forecasting Group
- T&D: Transmission and Distribution
- TOU: Time-of-Use
- TRM: Technical Resource Manual
- UCT: Utility Cost Test
- UCAP: Unforced Capacity
- VAR: Volt-Amp Reactive
- VPN: Virtual Private Network
- WTP: Willingness to Participate
- XEFORd: Equivalent Forced Outage Rate Demand excluding causes of outages that are outside management control

AES Indiana