# Reliability, Resilience and Stability Metric

# Risk & Opportunity Metrics

| | | 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 | | | | |

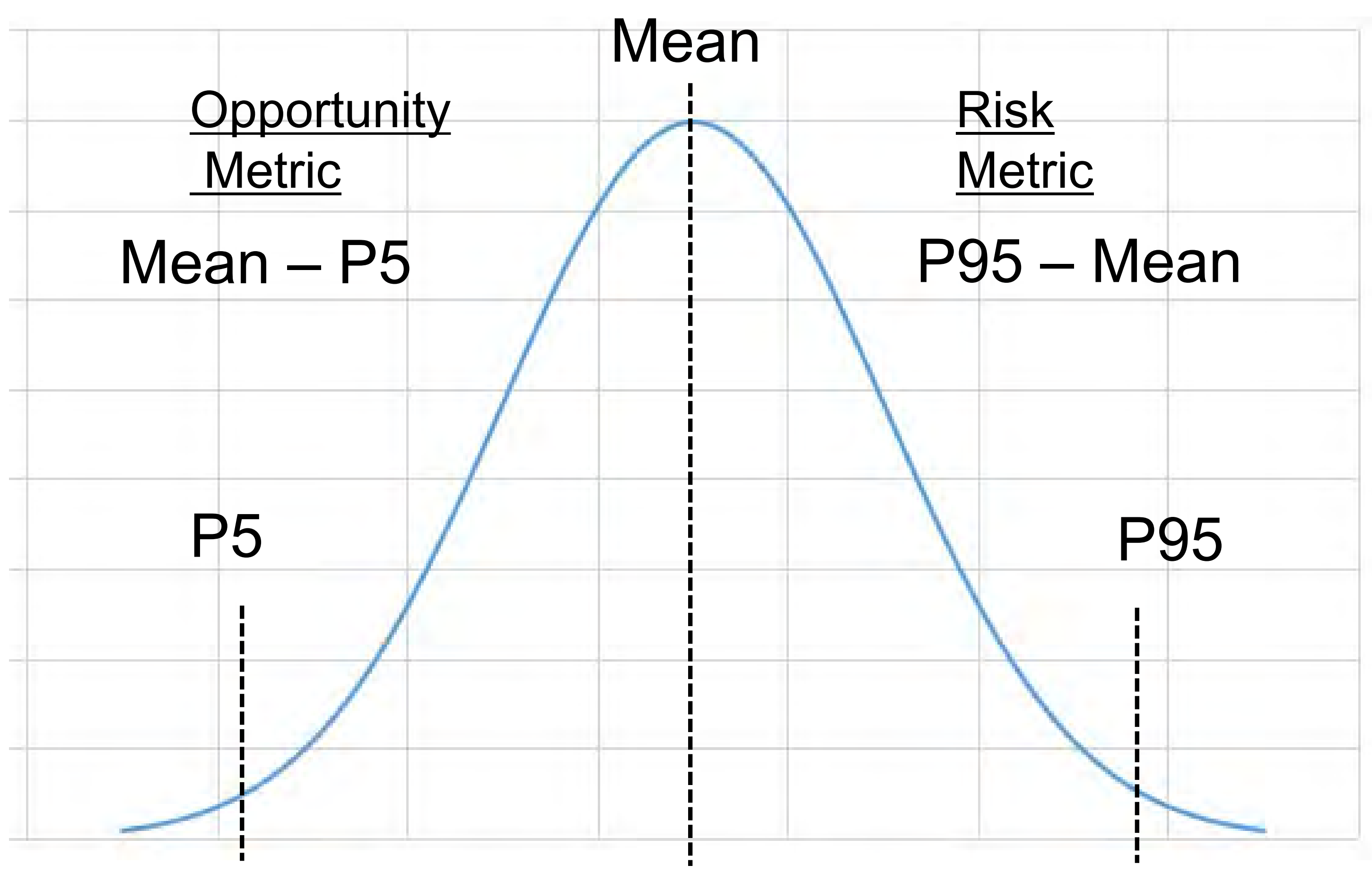
Run the Optimized Reference Case Portfolios/Generation Mixes through the other Scenarios

## 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**

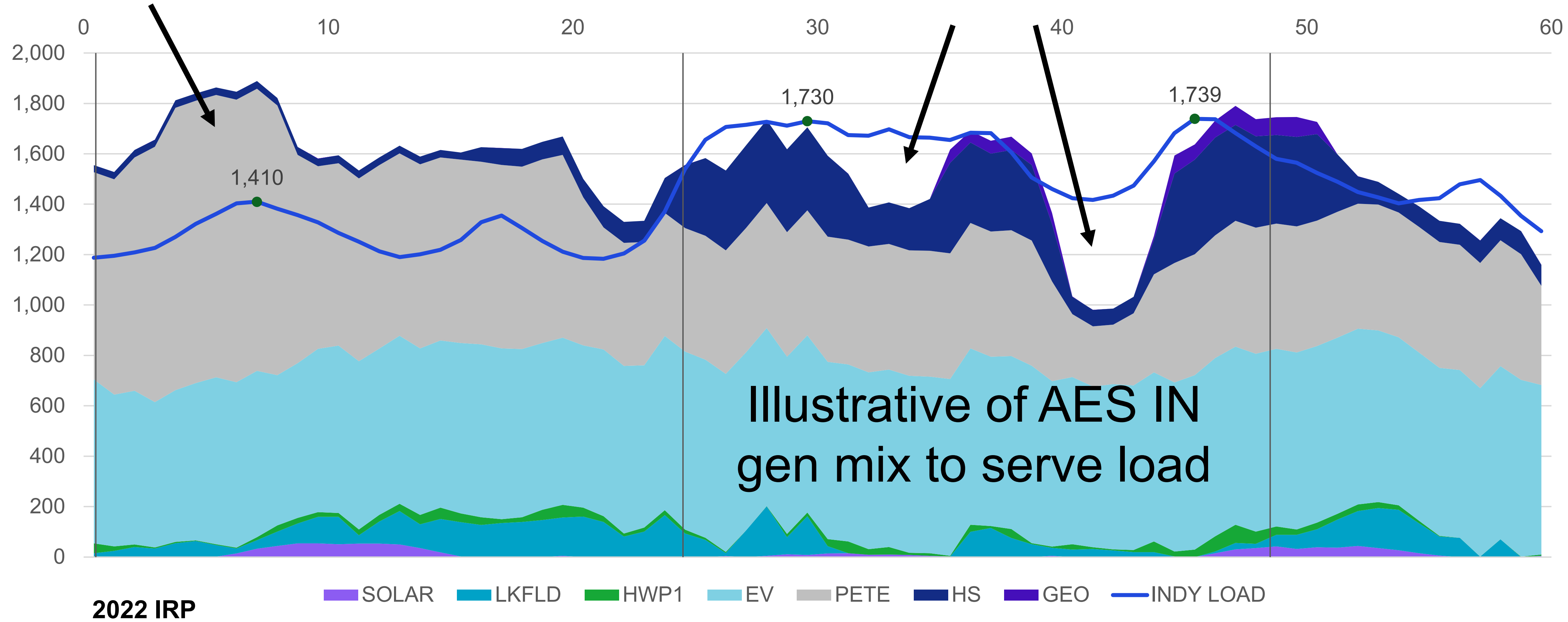
# Risk & Opportunity Metrics



# Risk & Opportunity Metrics

Sales

Purchases




Day 1 Day 2 Day 3

## Market Exposure Metric

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

$$\left| \text{20-year Average Sales} \right| + \left| \text{20-year Average Purchases} \right|$$



aes Indiana

# Economic Impact Metrics

# IRP Scorecard for Portfolio Evaluation

| | Affordability | Environmental Sustainability | | | | Reliability, Stability & Resiliency | Risk & Opportunity | | | | | | Economic Impact | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***20-yr PVRR*** | ***$CO_2$ Emissions*** | ***$SO_2$ Emissions*** | ***$NO_X$ Emissions*** | ***Other Emissions*** | ***Reliability Score*** | ***Environmental Policy Opportunity*** | ***Environmental Policy Risk*** | ***Cost Opportunity*** | ***Cost Risk*** | ***Market Exposure*** | ***Renewable Capital Cost Risk*** | ***Employees (+/-)*** | ***Property Taxes*** |
| | Present Value of Revenue Requirements | Total portfolio CO2 Emissions | Total portfolio SO2 Emissions | Total portfolio NOx Emissions | Water Use & Coal Ash | Composite score from Reliability Analysis | Lowest PVRR across policy scenarios | Highest PVRR across policy scenarios | Mean - P5 | P95 - Mean | 20-year avg sales + purchases | **TBD** | Total # of AES IN generation employees | Total amount of property tax paid from AES IN assets |
| **1)** | | | | | | | | | | | | | | |
| **2)** | | | | | | | | | | | | | | |
| **3)** | | | | | | | | | | | | | | |
| **4)** | | | | | | | | | | | | | | |
| **5)** | | | | | | | | | | | | | | |
| **6)** | | | | | | | | | | | | | | |

Calculations for each scoring metric will be included to complete the Scorecard

- **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



aes Indiana

**A Preferred Resource Portfolio will be selected after evaluation of the Scorecard results**

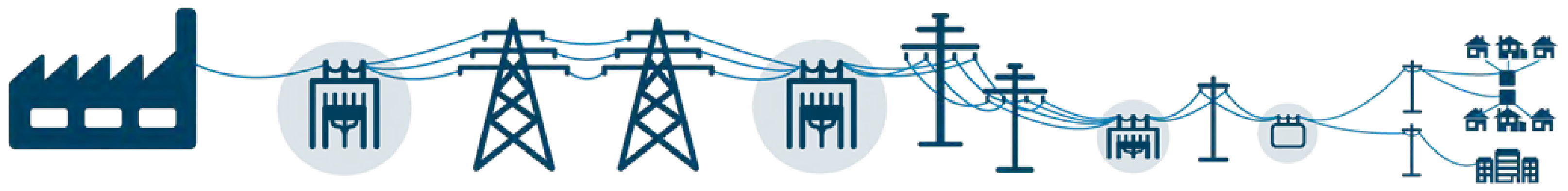
# AES Indiana Distribution System Planning

# Agenda

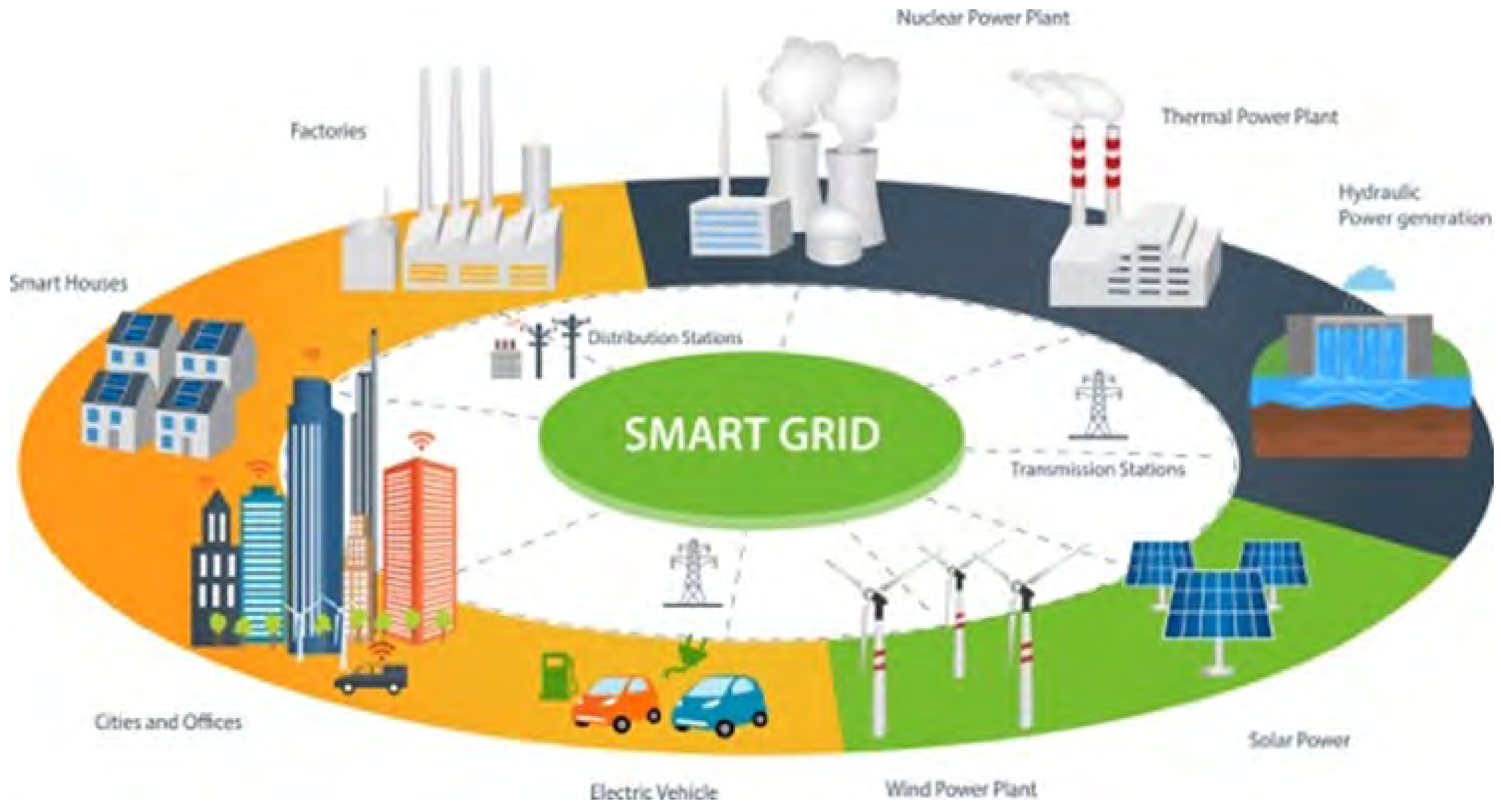
# Building the AES of the Future

Transforming the traditional one-way grid into…

An interactive two-way intelligent platform



AES Indiana






aes Indiana

# Smart Grid Vision

**CUSTOMER**

Engage with our customers through a more personalized experience and build a trusted customer relationship.

**SMART GROWTH**

Build a distribution system that attracts new customers through innovative clean energy products and services.

**INNOVATION**

Transform to a customer-focused, data-driven culture that empowers our people to reimaging the energy ecosystem and be leaders in the clean energy transition.

**RESILIENCY**

Transform our energy system and services to improve resiliency and seamlessly integrate renewables, distributed generation, energy storage and electrification technologies.

# Operations Future State Vision

**DMS** – Distribution Management System
**OMS** – Outage Management System
**DERMS** – Distributed Energy Resources Management System
**AMI** – Advance Metering Infrastructure

## Enterprise Integration

- GIS
- CIS
- Work Management
- AMI/MDMS
- Weather Service
- Outage Data Warehouse

DER Dispatch
DER Forecast
DER Monitoring and Control
DER Market Interface
DER Scheduling
DER Estimation

Storm Management
Outage Analysis
Call Management
Planned Outage Management
Outage Reporting
Crew Management

Switch Order Management
Volt/Var Optimization
Distribution Power Flow
Feeder Reconfiguration
Fault Location Restoration
Short Circuit Analysis

## Distribution Network Operating Model

Network Model | Topology Processing | Graphical User Interface | DER Modeling | DER Aggregation

## Operations Technology Platform

SCADA, Alarming, Trending, Visualization, Historian, Load Shed, Study Mode

**Real-Time/DER Communication**

Dispatchable Generators | Substation Devices | Feeder Devices | EVs and Charging Stations | Wind | DR and Smart Appliance | Energy Storage | Solar Pv | Microgrids

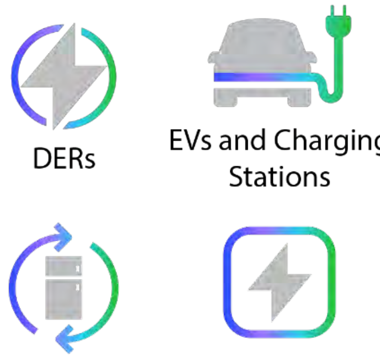
## Mobile Application

- Real Time Map View
- Job Management
- Damage Assessment
- Field Switching
- Off-Line Operation
- GPS Integration



aes Indiana

# Connected Planning & Operations



DERs | EVs and Charging Stations | DR and Smart Appliance | Energy Storage

**Interconnection Portal**
Collect all technical specifications needed for detailed modeling

**Demand Forecasting Tool**
In alignment with resource planning develop bottom-up geo-referenced forecasts, with forecast updates as a result of resource changes and information from smart grid devices

**Network Model Building & Analysis**
Develop short, mid, long term power flow study models for T&D systems

**Grid Upgrades**
Develop solutions for grid interconnection, capacity, and reliability needs

**DER Dispatch**
**DER Forecast**
**DER Monitoring and Control**
**DER Market Interface**
**DER Scheduling**
**DER Estimation**

**Storm Management**
**Outage Analysis**
**Call Management**
**Planned Outage Management**
**Outage Reporting**
**Crew Management**

**Switch Order Management**
**Volt/Var Optimization**
**Distribution Power Flow**
**Feeder Reconfiguration**
**Fault Location Restoration**
**Short Circuit Analysis**

- Collecting all technical data at the front of the interconnection process and translating it directly to standardized forecasting and modeling tools in planning & operations.
- Leveraging Smart Grid investments for better forecasting and model inputs.
- Devices are utilized for better operational visibility & orchestration leading to better customer outcomes.

## Smart Grid Devices

AMI, Smart Reclosers, Sensors, SCADA/Pi, Weather data utilized to build better modes and provide an operations technology platform that enhances planning and operations

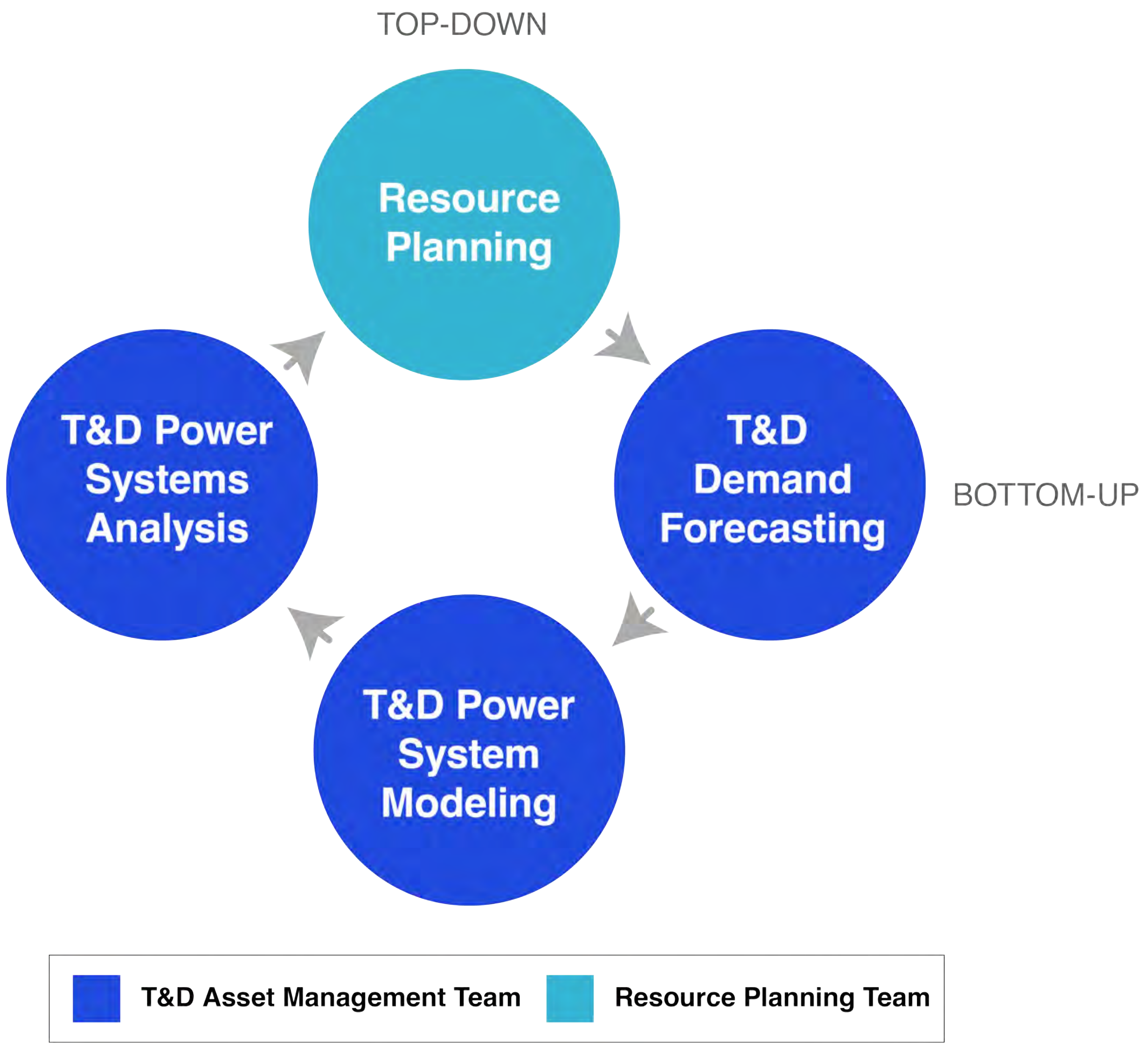
AMI – Smart Meters | Substation Devices | Line Reclosers | DR and Smart Appliance

**DMS** – Distribution Management System
**OMS** – Outage Management System
**DERMS** – Distributed Energy Resources Management System
**AMI** – Advance Metering Infrastructure



aes Indiana

# Aligned Planning at AES Indiana



# T&D Demand Forecasting Future State Process

**Smart Grid Device Inputs** → **Demand Forecasting** → **System Modeling & Analysis Output**

SAP OSIsoft

LoadSEER

PSS®E CYME Power Engineering Software

## Asset Data
- FLOC
- SCADA/PI
- AMI
- DER Data
- GIS
- Co-op/Muni Data
- Block Load

Landis+Gyr esri

## Load Analysis
- SCADA Scrubber
- AMI Pipeline
- Load Normalization
- Model 30 Weather Years
- Hourly Load Profiles

## Resource Planning
- Utility Internal Projections as Constraints

*(top-down)*

## Spatial Analysis
- Geo-referenced
- Econometrics
- Demographics
- Transportation
- Probability of Load Growth and DER Penetration

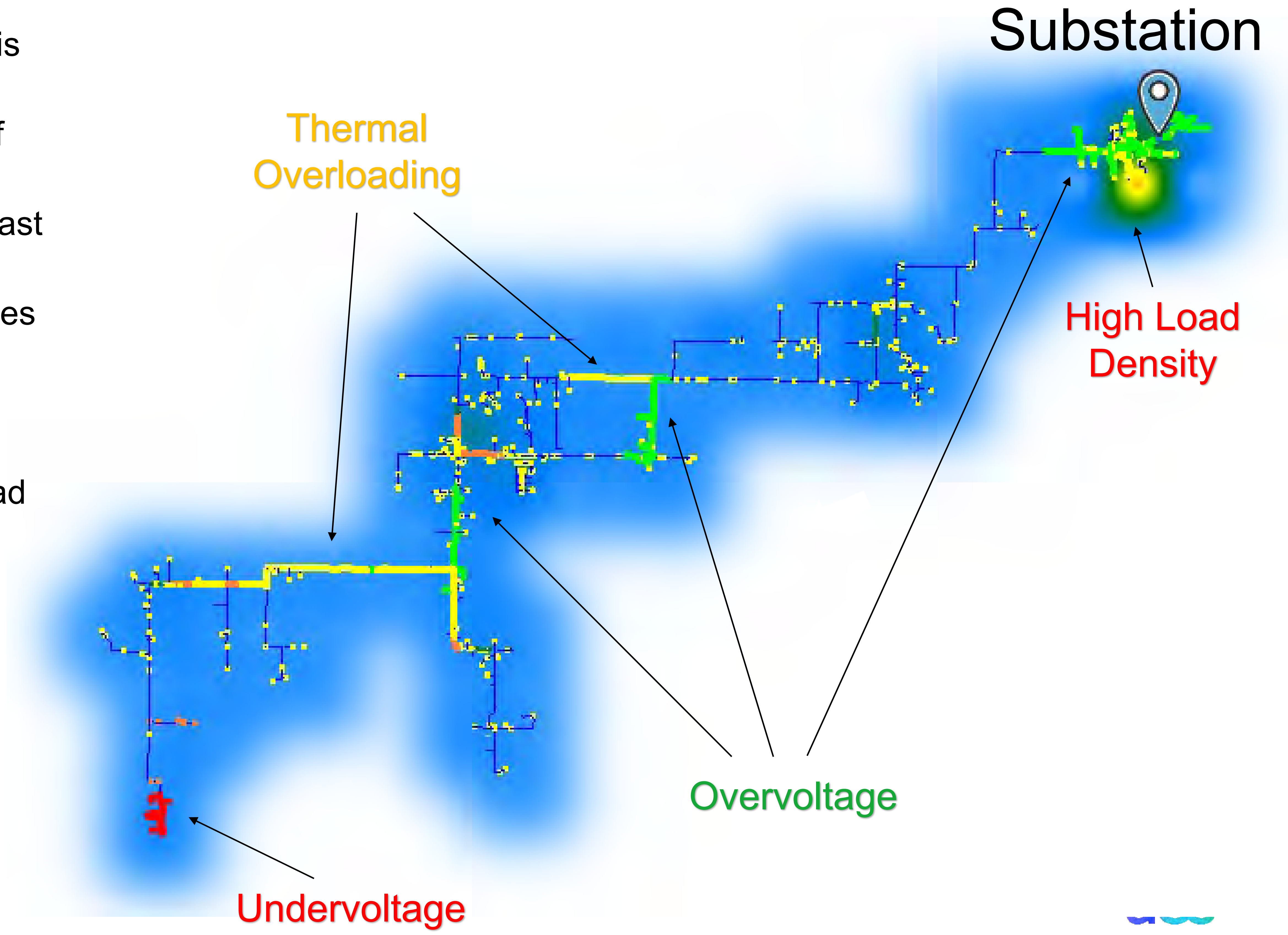
*(bottom-up)*

## Multi-Scenario Development
- Short, Mid, Long-Term Scenarios
- Low, Medium, High Growth Rates
- DER/EV Sensitivities
- Weather Sensitivities

## Power Flow Models
- CYME
- PSSE
- Export to GIS for Visualization
- Aligned Study Models for T&D in Indiana + Ohio

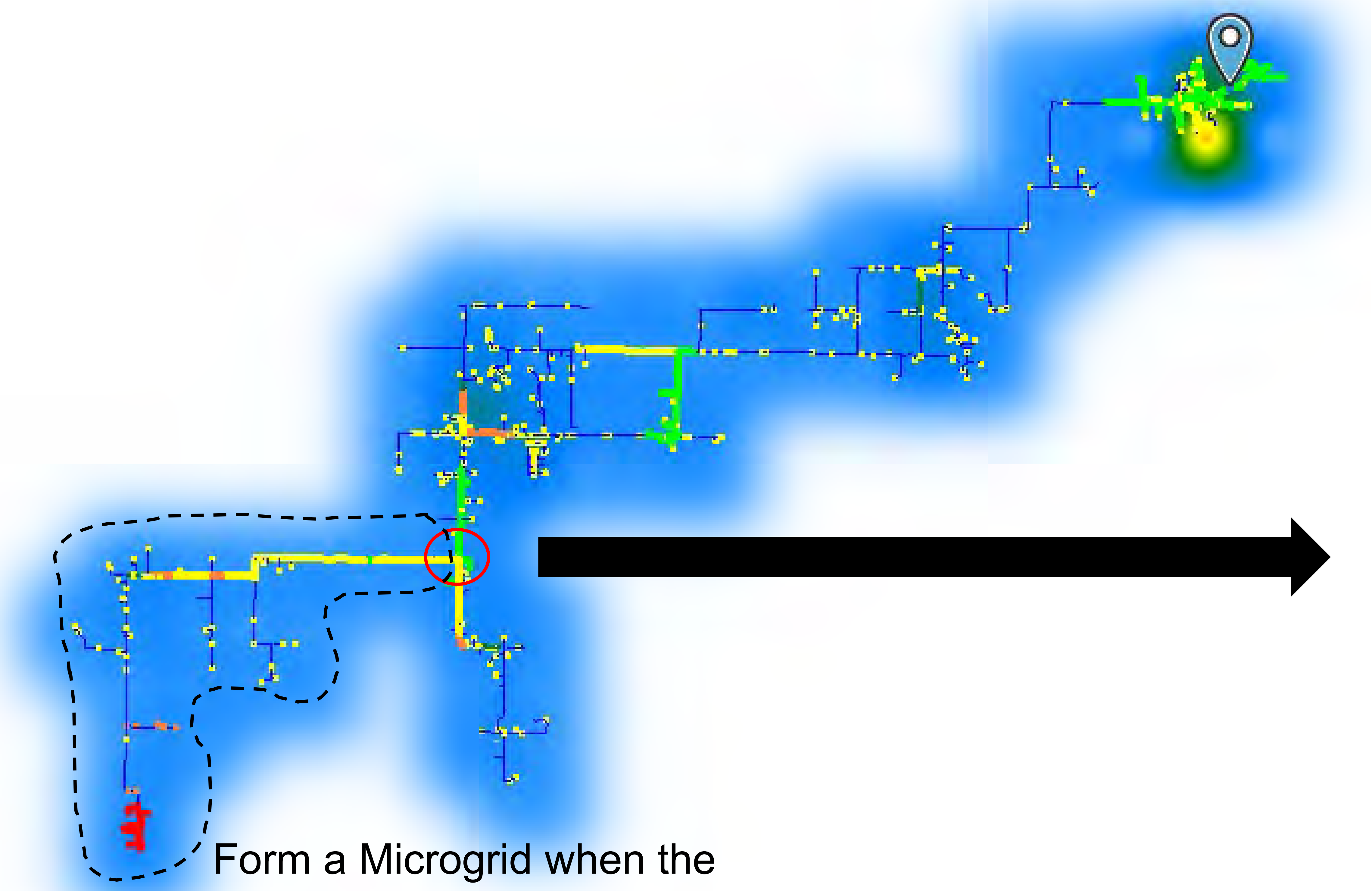
# Load Flow Analysis for Distribution Systems

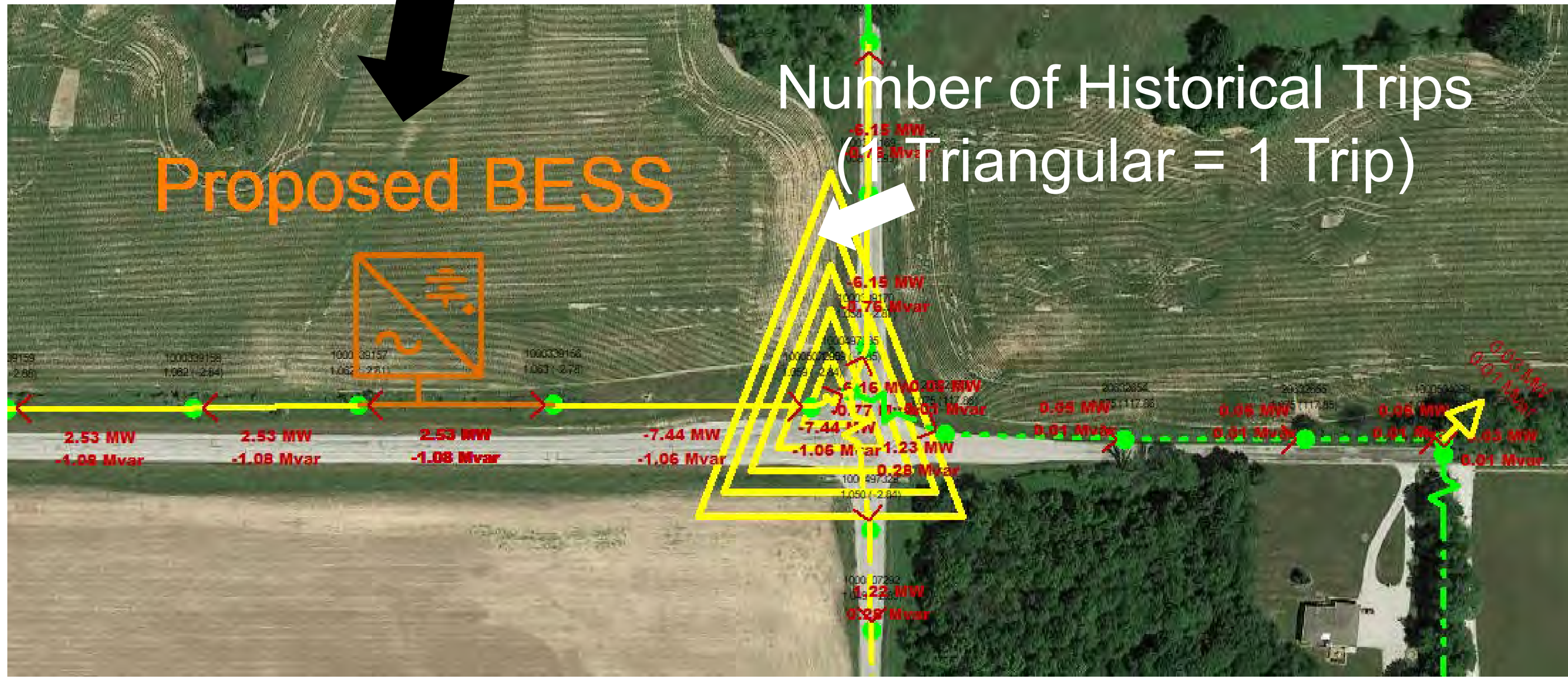
- AES uses CYME for distribution system modeling and analysis
- CYME takes advanced forecasts/scenarios from our demand forecasting tool (LoadSEER) to develop power flow models of the system
  - These forecasts and scenarios will be analyzed to forecast future system capacity, redundancy, and voltage needs
  - Contingency & Scenario Planning present new challenges for distribution since multiple circuit configurations are possible with smart grid devices
- Time series for load profiles
  - Will become more important over time with changing load profiles due to DER, EV charging, etc. being major load modifiers
- Advanced Capabilities Under Development
  - Reliability Assessment
  - Recloser Placement Module
  - Time Series
  - Hosting Capacity



# Example of a Battery Energy Storage System (BESS) (a Non-Wire Alternative)

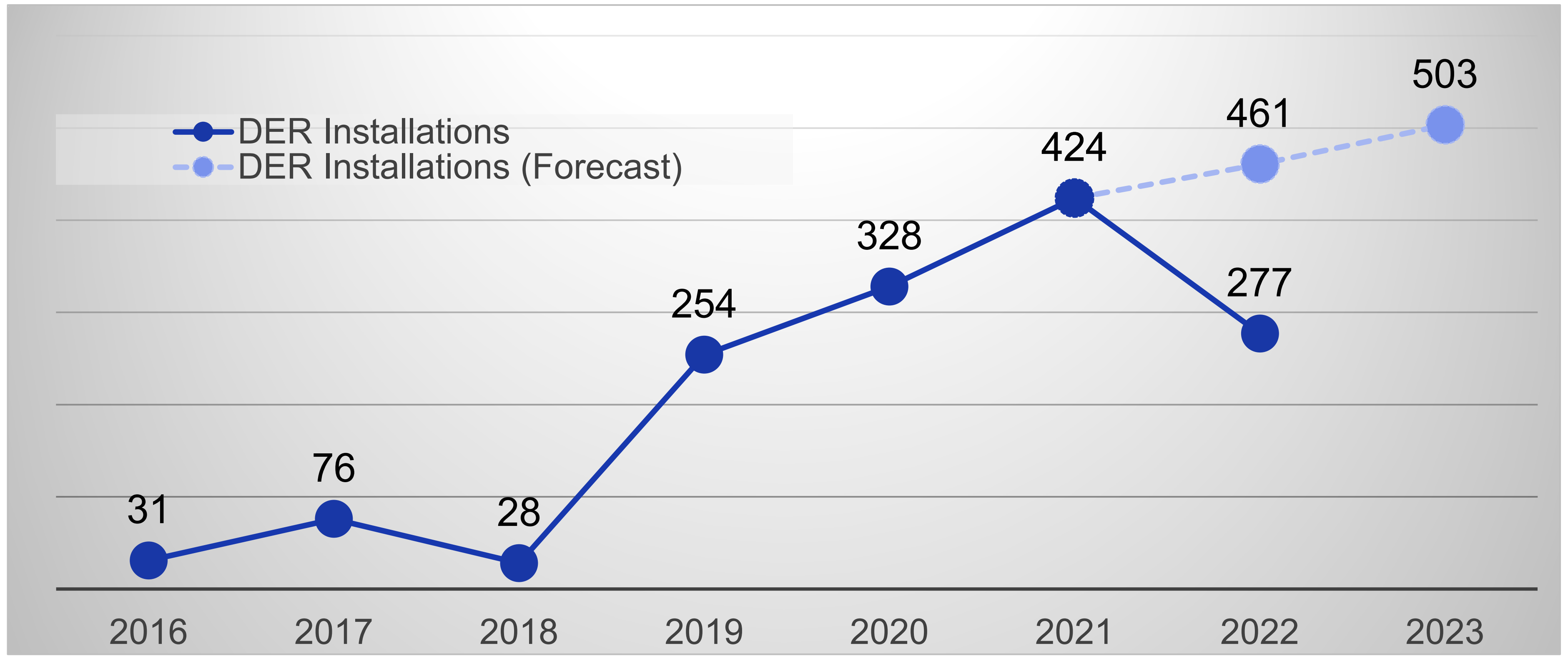
Substation

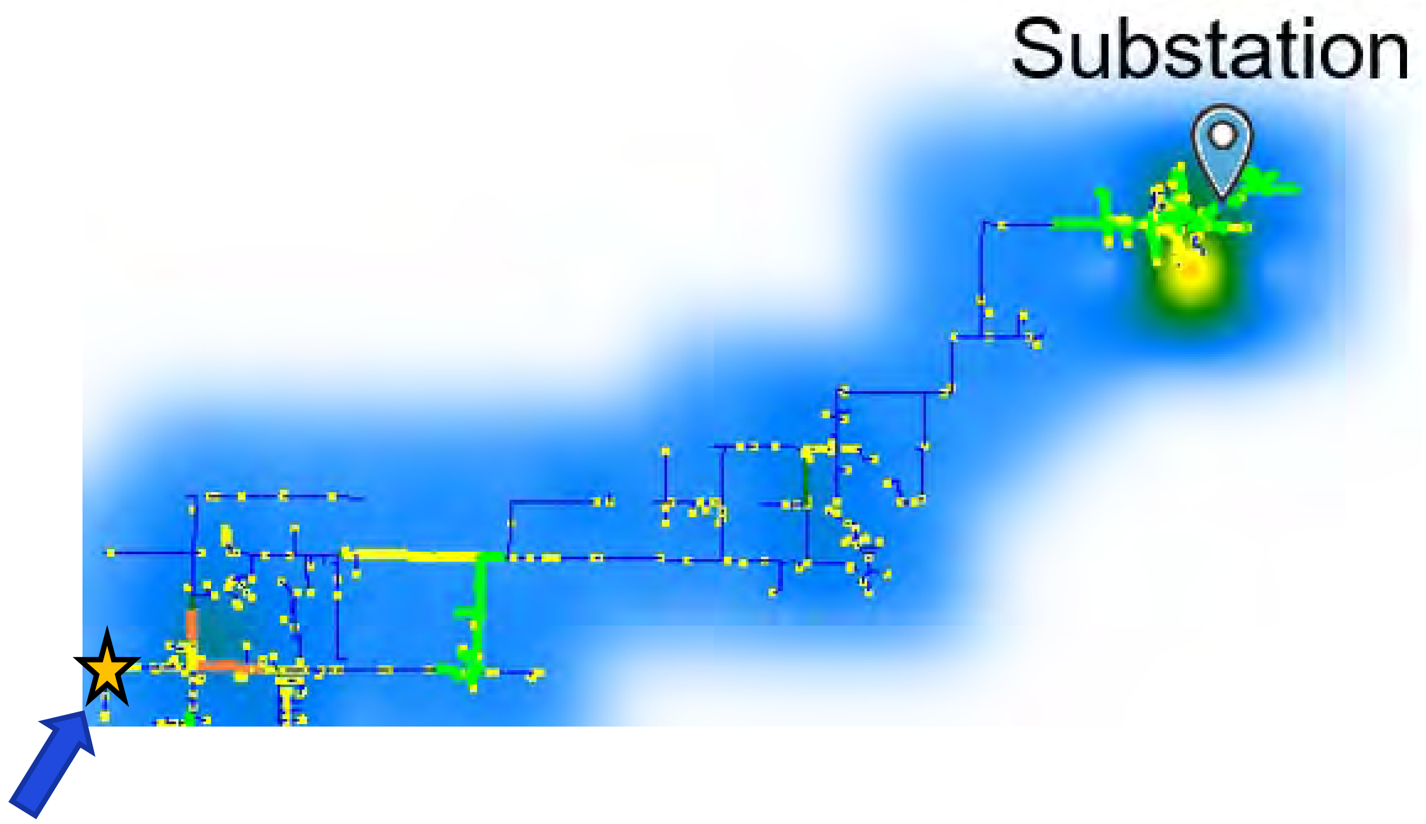



Form a Microgrid when the highlighted isolation device trips

# Distributed Energy Resources




Targeted solar to solve thermal issue, part of planning toolbox

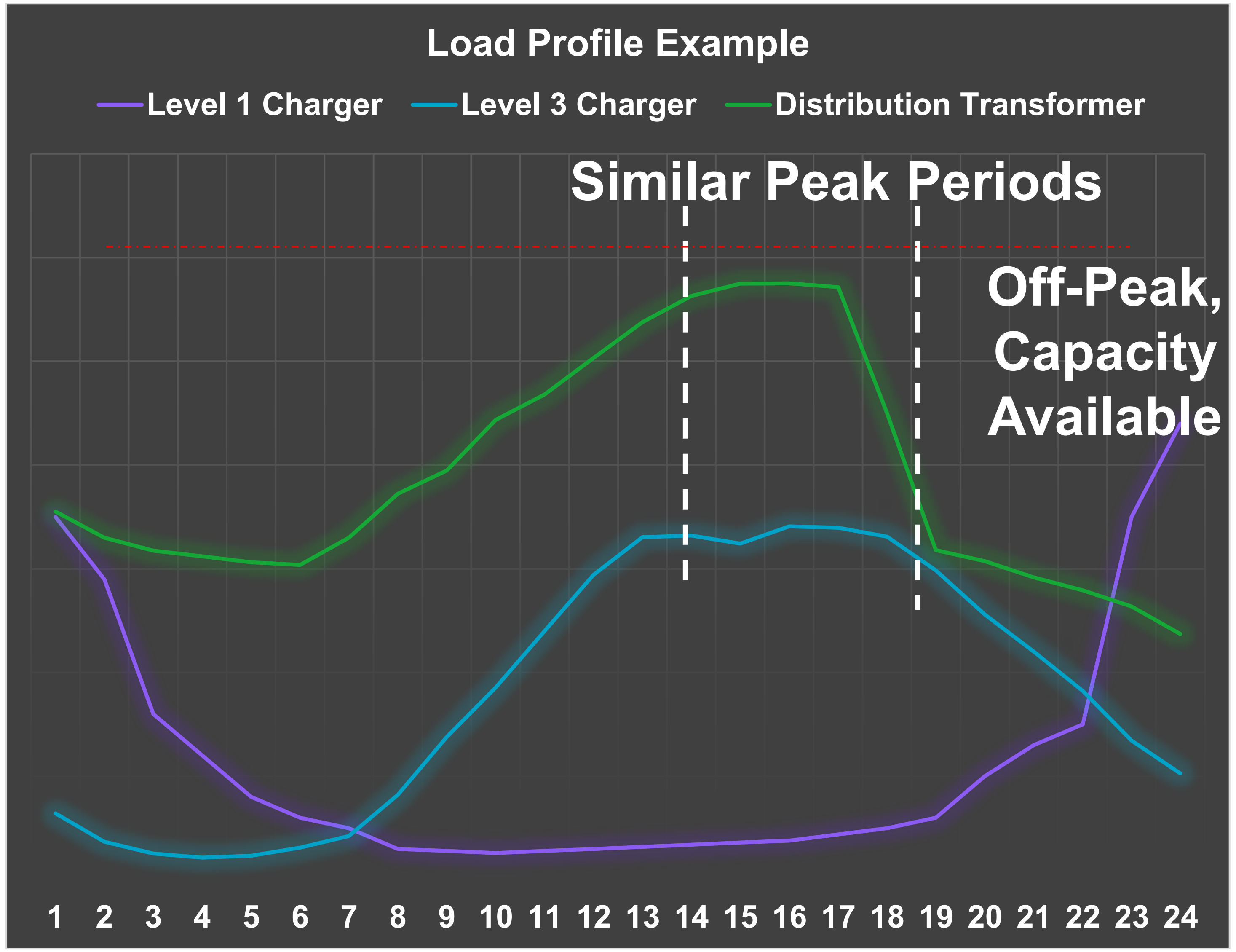


aes Indiana

# Electric Vehicles

## Distribution planning considerations for electric vehicles (ev's)

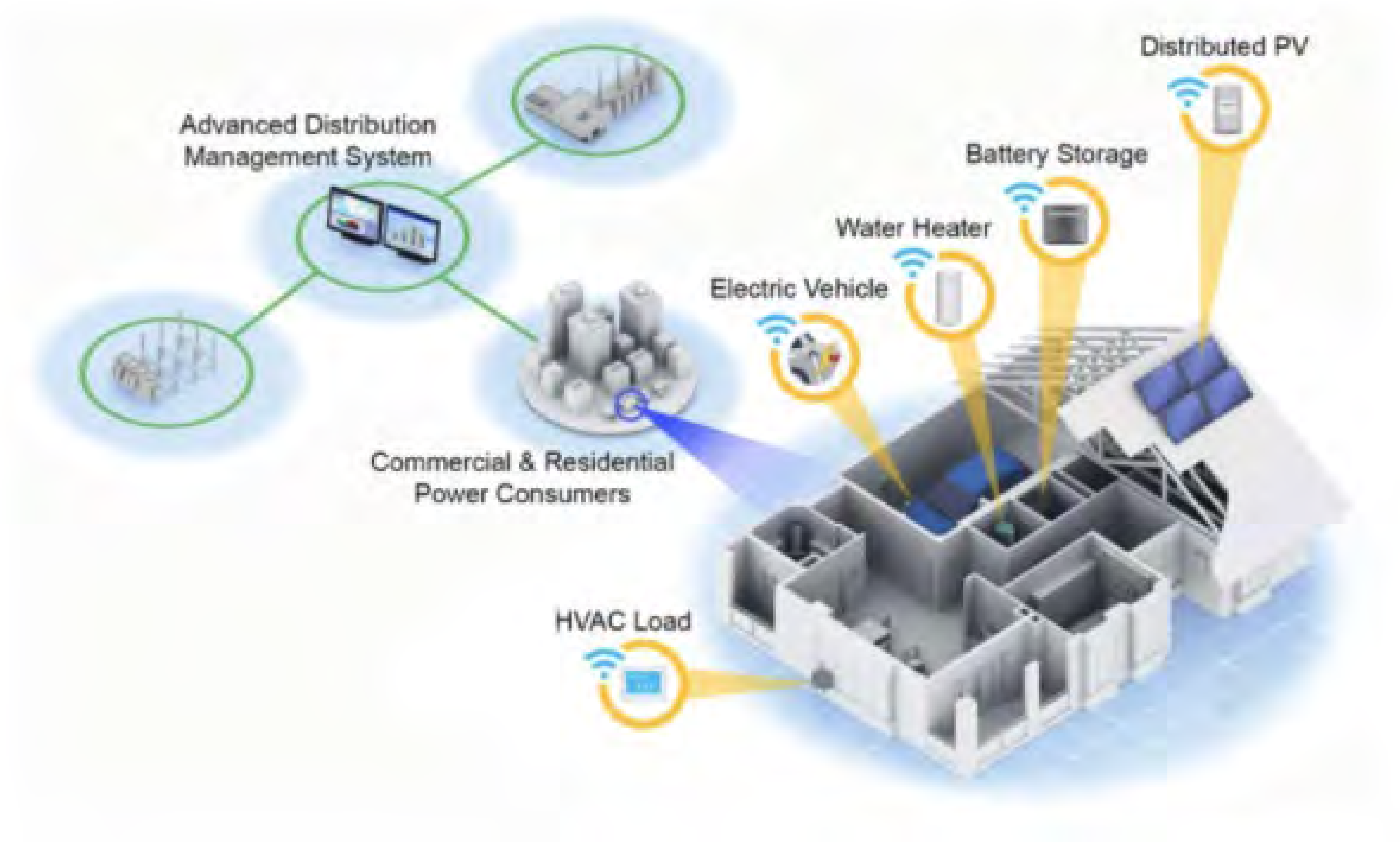
- Level 1 and 2 charging are generally manageable for capacity planning assuming effective time of use (TOU) charging rates are in place.
- Level 3 charging is more problematic due to the peak load occurring simultaneously with the grid peak and at much higher magnitudes.
- Fleet charging requests have been limited but we see the potential for very large loads in this space that may have a major impact on system planning.




## Demand forecasting & network modeling

- AES will account for EV growth by taking the resource planning top-down forecast and utilizing our demand forecasting parcel level EV propensity model to allocate it down to the circuits and feeders.
- AES will study the multiple scenarios developed around EV charging in our network models to determine if capacity upgrades will be required. In combination with other system needs on a particular circuit, there could be multiple ways to plan for solutions such as traditional asset upgrades, strategic battery placements, optimally placed circuit ties, optimal DER placements, etc.

# FERC Order 2222



# Importance of FERC Order 2222

- FERC Order No. 2222 enables distributed energy resources (DERs) aggregators to compete in wholesale electric markets such as MISO
- DERs can range from solar to battery storage, demand response, energy efficiency, thermal storage, electric vehicles and their charging equipment. DERs can locate on the distribution system and/or behind a customer meter


**Distribution Planning Considerations:**

- Distribution Aggregation studies will need to be completed.
- Furthers the need for connected T&D systems, processes, and interconnection portals as DER is integrated into MISO markets.
- Modernization of interconnection databases for tracking all DERs and their technical specifications.
- Potential for significant increases to DER interconnection study volumes, complexity, and size expected.
- Long-term forecasting of DERs, DERAs, and their performance impacts
- Potential need for distribution energy storage locally to manage the variability on each circuit.

**Expedites and further justifies the need to expand smart grid operations & programs (AMI, ADMS, GIS, etc.).**

- Basic levels of visibility and monitoring will be required for the continued safe operation of the system.
- Need to perform RTO day ahead and real time market studies with adequate visibility and monitoring.
- Enhancement of distribution system operator and market roles.

# Conclusion

**Strategic Organizational Alignment between Resource & T&D planning**

**Advanced Demand Forecasting, Connected top-down & bottom-up load forecasting**

**Advanced Modeling & Analysis, utilization of advanced power flow tools**

**Cutting-Edge Grid Operations, Utilization of ADMS to be Grid of the Future**

# 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** | **August 2022** | **October 2022** |

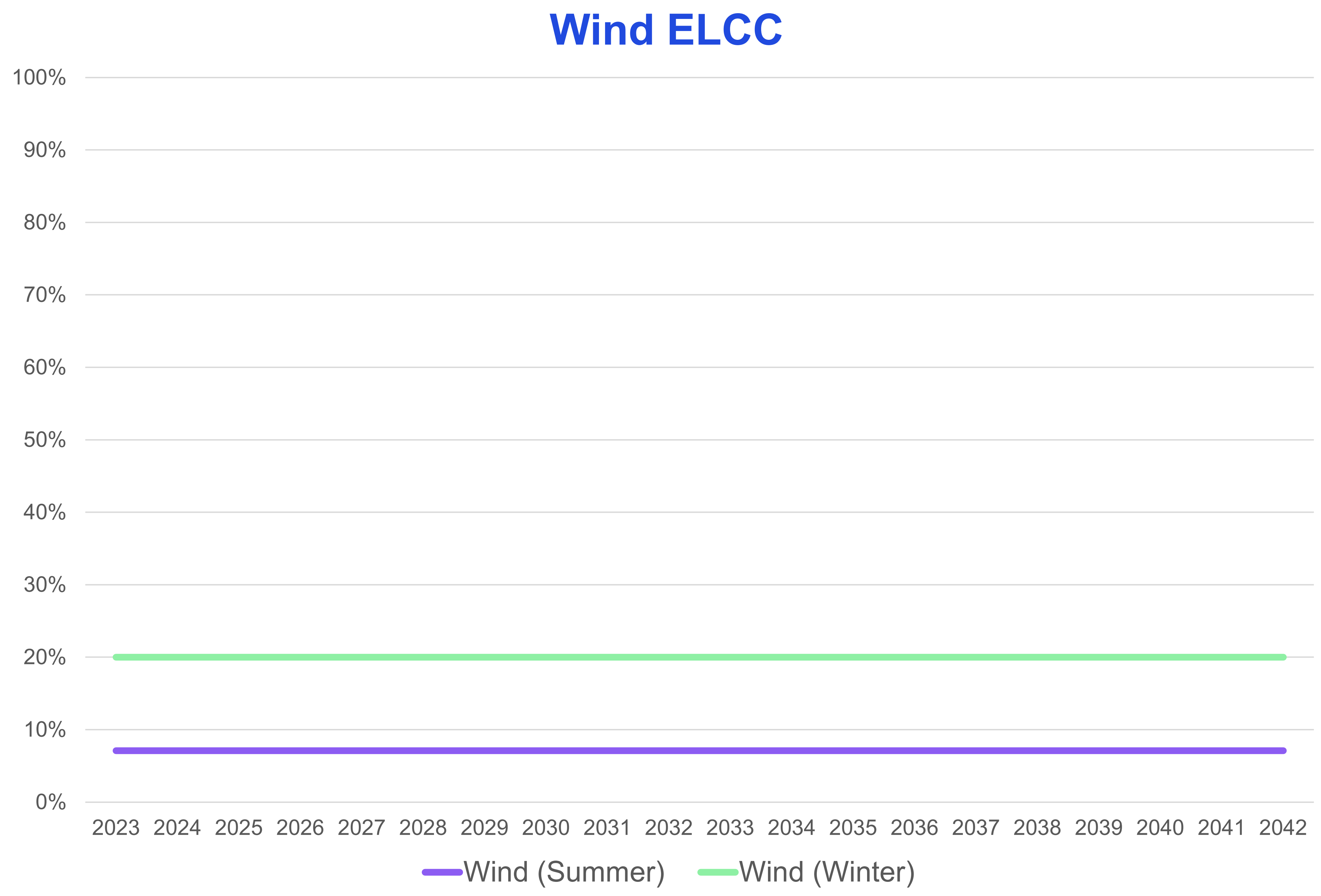
- All meetings will be available for attendance via Teams. Meetings in 2022 may also occur in-person.
- A Technical Meeting will be held the week preceding each Public Advisory Meeting for stakeholders with nondisclosure agreements. Tech Meeting topics will focus on those anticipated at the next Public Advisory Meeting.
- Meeting materials can be accessed at ***www.aesindiana.com/integrated-resource-plan.***

# Thank You

# Appendix

# Wind Parameters

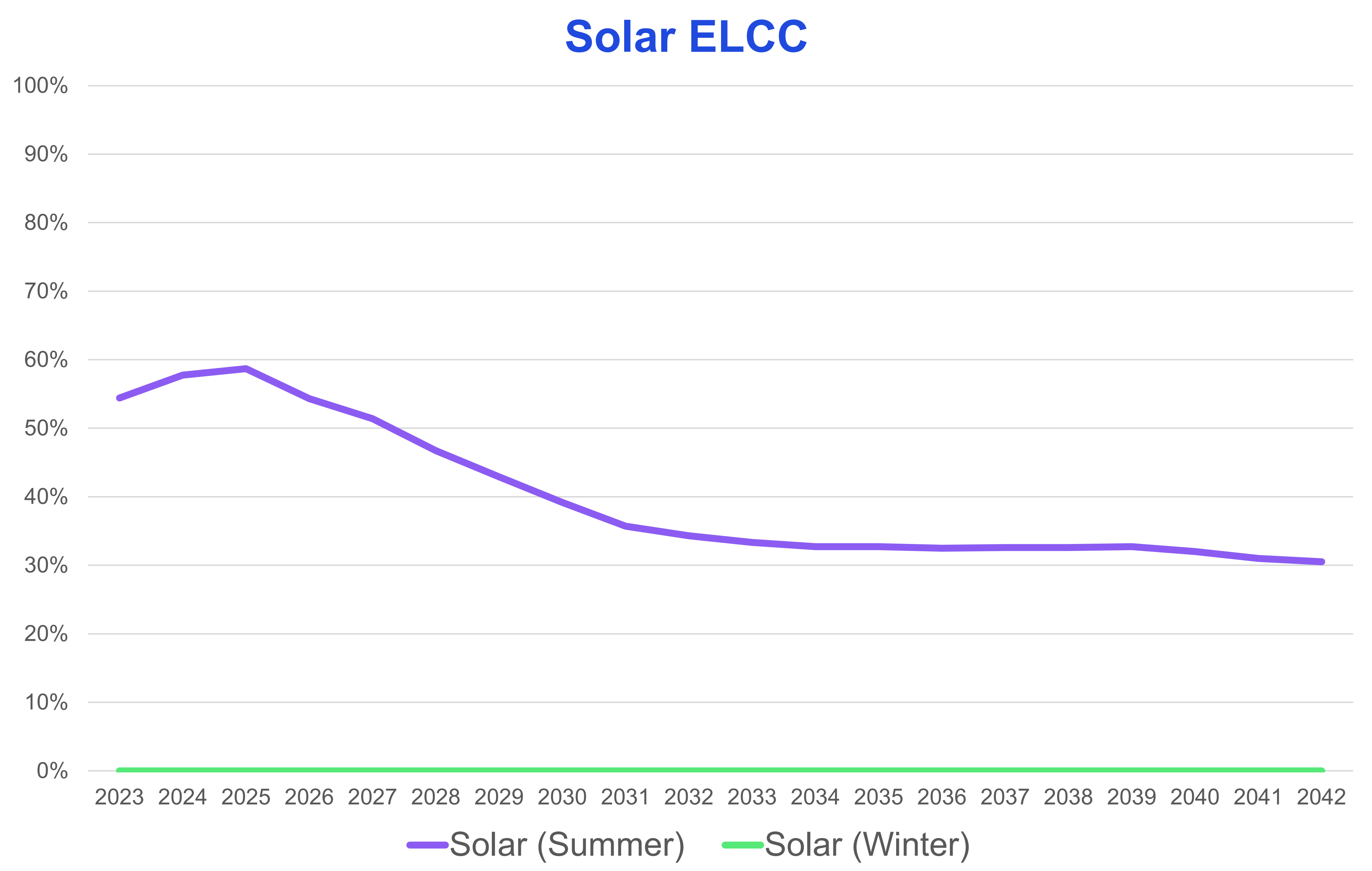
- **Location:** Indiana
- **Annual Capacity Factor:** 33.6 – 40.4%
- **Source Profile:** NREL System Advisory Model (SAM)
- **Project Size:** 50 MW ICAP
- **Useful Life:** 30 years
- **Summer ELCC (2025):** 7.1%; *Source: Horizons Energy*
- **Winter ELCC:** 20%; *Source: MISO RAN*





AES Indiana

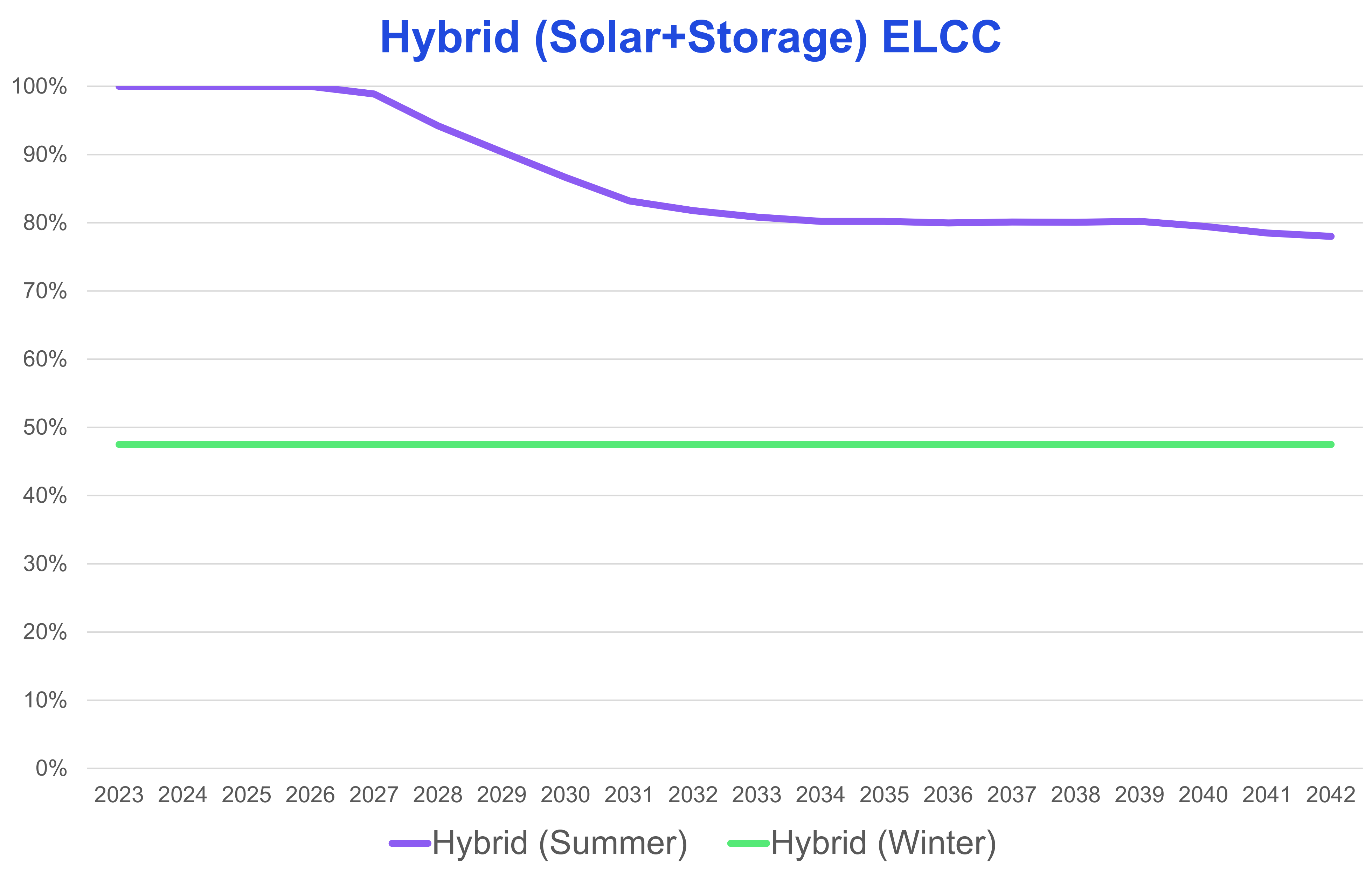
# Solar Parameters




*Summer ELCC forecast presented in chart is from the Horizon Custom Reference Case – ELCC forecast will vary by custom scenario

# Solar + Storage Parameters

- **Location:** Petersburg, Indiana
- **System:** DC Coupled Solar + Storage System, Storage charges exclusively from the solar array
- **Solar Component:** Identical to stand-alone solar (25 MW ICAP)
- **Storage Component:** 12.5 MW ICAP | 50 MWh
- **Synergies:** 4.3% reduction in capital costs, 2% improvement of RTE
- **Summer ELCC (2025):** 100%
- **Winter ELCC:** 48%



# IRP Acronyms

https://www.aesindiana.com/integrated-resource-plan.

# IRP Acronyms

- 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 Selective Catalytic Reduction System
- EV: Electric Vehicle
- FLOC: Federated Learning of Cohorts
- GDP: Gross Domestic Product
- GFL: Grid-Following 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
- IEEE: Institute of Electrical and Electronics Engineers
- IRP: Integrated Resource Plan

# IRP Acronyms

- 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
- RTO: Regional Transmission Organization
- SAC: MISO's Seasonal Accredited Capacity
- SAE: Small Area Estimation
- SCADA: Supervisory Control and Data Acquisition
- 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

# 2022 Integrated Resource Plan (IRP)

Public Advisory Meeting #4

*9/19/2022*

aes Indiana

# Agenda and Introductions

**Stewart Ramsay,** Managing Executive, Vanry & Associates

# Agenda

| Time | Topic | Speakers |
|---|---|---|
| **Morning**<br>**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 |
| | Stakeholder Presentations | Bhawramaett Broehm, Market Development Analyst, Wartsila<br>Marcus Nichol, Senior Director, Nuclear Energy Institute |
| | IRP Schedule & Timeline | Erik Miller, Manager, Resource Planning, AES Indiana |
| | IRP Framework Review & Modeling Updates | Erik Miller, Manager, Resource Planning, AES Indiana |
| | Retirement & Replacement Analysis Results | Erik Miller, Manager, Resource Planning, AES Indiana |
| **Break**<br>**12:00 PM – 12:30 PM** | Lunch | |
| **Afternoon**<br>**Starting at 12:30 PM** | Replacement Resource Cost Sensitivity Analysis Results | Erik Miller, Manager, Resource Planning, AES Indiana |
| | Preliminary IRP Scorecard Results | 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
Alliance Coal
Barnes & Thornburg LLP
Bose, McKinney & Evans LLP
CenterPoint Energy
Citizens Action Coalition
City of Indianapolis
Clean Grid Alliance
Demand Side Analytics
Develop Indy | Indy Chamber
Energy Futures Group
Faith in Place
Hallador Energy
Hoosier Energy
Hoosier Environmental Council
IBEW Local Union 1395
Indiana Chamber
Indiana DG
Indiana Distributed Energy Alliance
Indiana Energy Association
Indiana Office of Energy Development
Indiana Utility Regulatory Commission
Indiana State Conference of the NAACP

IUPUI
M&G
Midwest Energy Efficiency Alliance
Midcontinent Independent System Operator (MISO)
NIPSCO
Nuclear Energy Institute
NuScale Power
Office of Utility Consumer Counselor
Power Takeoff
Purdue - State Utility Forecasting Group
Ranger Power
Rolls-Royce/ISS
Sierra Club
Solar United Neighbors
UUI Green Team
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 Purpose & Values

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

Safety first

Highest standards

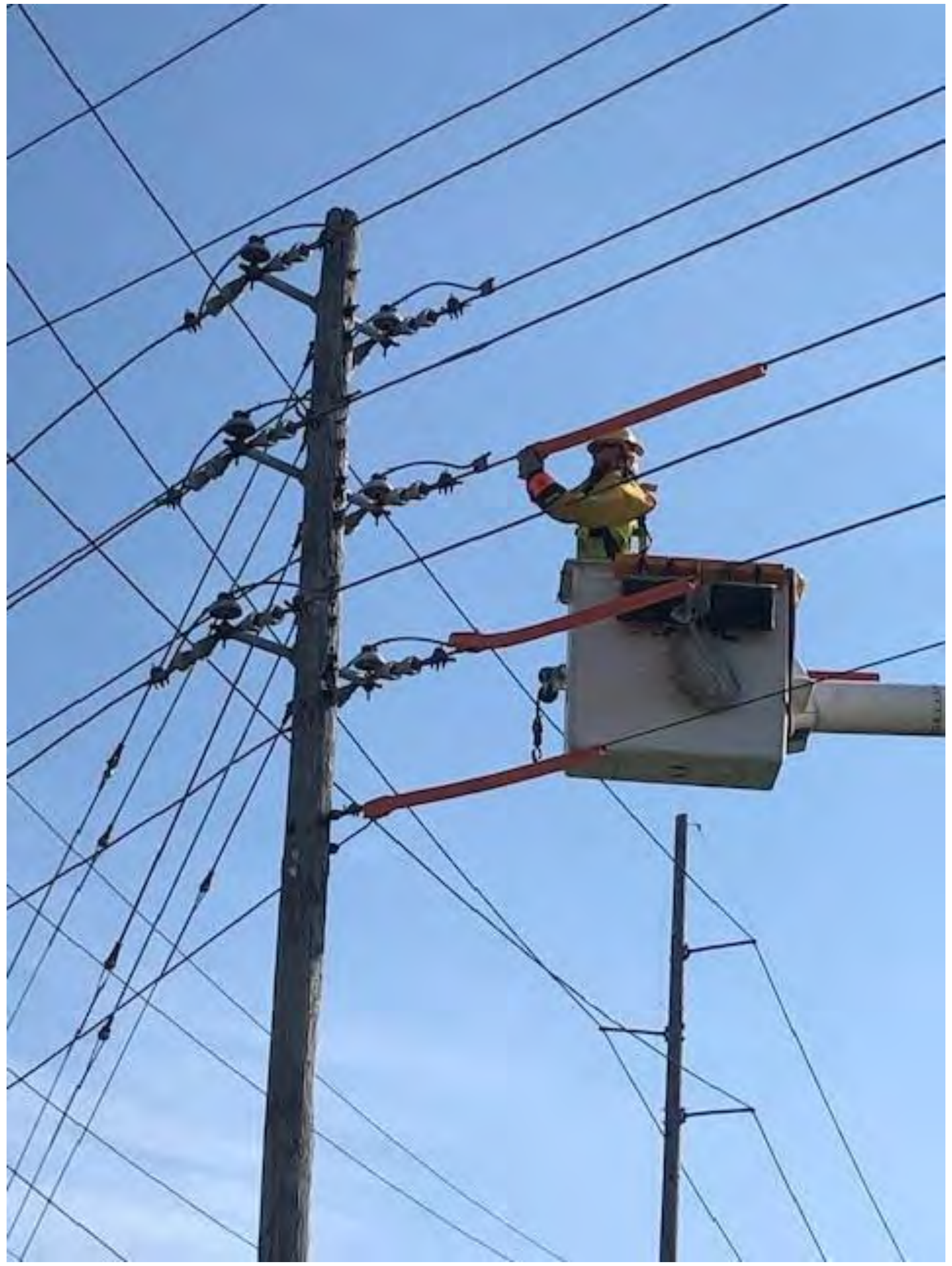
All together

# 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.



# IRP Overview

**Advisory Meeting #1 (January 24):** AES Indiana Resource Planning team recapped the 2019 IRP Short-Term Action Plan, introduced the IRP resource planning process and model overview, and highlighted existing resources, replacement resource options and future IRPs.

**Advisory Meeting #2 (April 12):** AES Indiana Resource Planning team presented load scenarios, results of the market potential study, commodity forecasts and distribution system planning items, and shared additional analysis of reliability that will give insight into how AES Indiana is working to ensure any changes to its portfolio maintain reliable service 24/7/365 for its customers.

# IRP Overview

**Advisory Meeting #3 (June 27):** AES Indiana's Resource Planning team discussed system planning and RTO reliability planning, presented content on modeling reliability, and provided an overview of Portfolio metrics and scorecard. We welcomed presentations from MISO, Sierra Club and Faith in Place.

**Today**, the AES Indiana Resource Planning team will cover results from preliminary core IRP modeling and the scorecard, which evaluates multiple strategies and scenarios using defined cost, environmental, reliability and risk metrics.

**We thank you for your input into this important process!**

# AES Indiana and the IRP

- The IRP is a unique opportunity for AES Indiana to engage with our customers, communities and stakeholders to analyze our energy future, together.

- The in-depth analysis and stakeholder input will position AES Indiana to best serve our customers' needs today and well into the future.




aes Indiana

# AES Indiana and Our Stakeholders


- The IRP process has allowed us to engage with many stakeholders through our Advisory Meetings and Technical Meetings and through their participation, questions, input and stakeholder presentations.
- We are listening and taking feedback seriously. Through our collaboration, the IRP team has:
  - Evaluated all feedback
  - Added the Clean Energy Strategy
  - Worked collaboratively with stakeholders on key inputs


aes Indiana

# Meeting our customers' needs today and tomorrow

AES Indiana
is leading the
**inclusive,**
**clean energy**
transition.

Reliability

Affordability

Sustainability



aes Indiana

# Stakeholder Presentations

**Bhawramaett Broehm**, Market Development Analyst, Wartsila

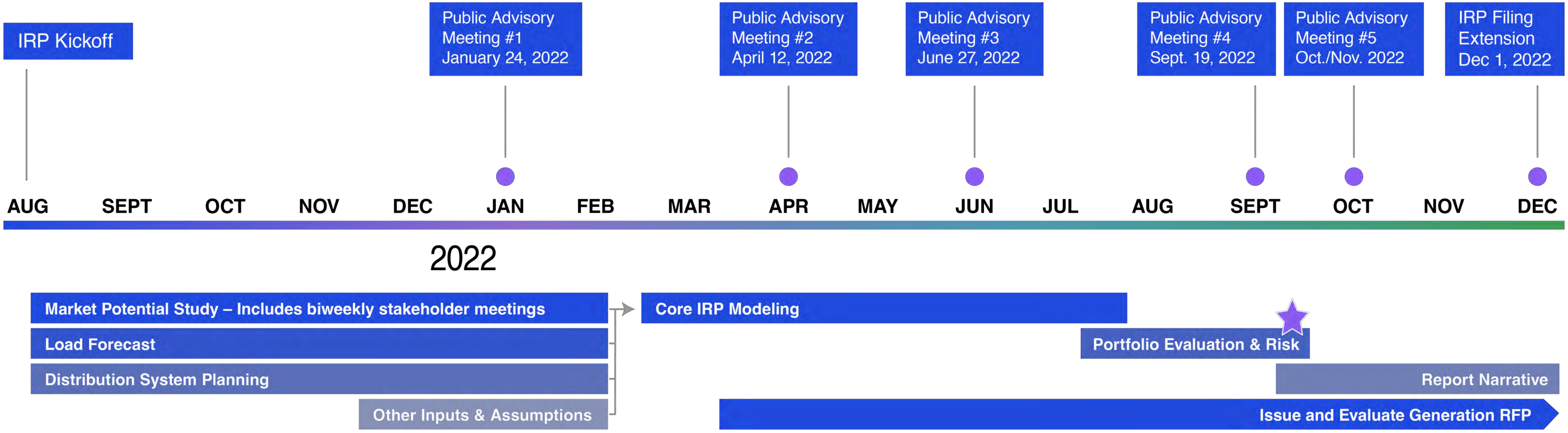
# Stakeholder Presentations

**Marcus Nichol**, Senior Director, Nuclear Energy Institute

# 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/November**

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

***Topics for meeting 5 are subject to change.***

# IRP Process Overview

**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

## Core IRP Modeling & Evaluation

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

**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

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

**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

# Modeling Updates & IRP Framework Review

**Erik Miller**, Manager, Resource Planning, AES Indiana



AES Indiana

# Model Constraints

Capacity Expansion models require constraints to provide meaningful results. There are three main constraints AES Indiana utilized:

## Limiting Capacity Purchases and Sales

→ Prevents the selection of a portfolio that relies excessively on market purchases for capacity or on uncertain revenues associated with selling capacity. The constraint is ~50 MW.

## Limiting Energy Purchases and Sales

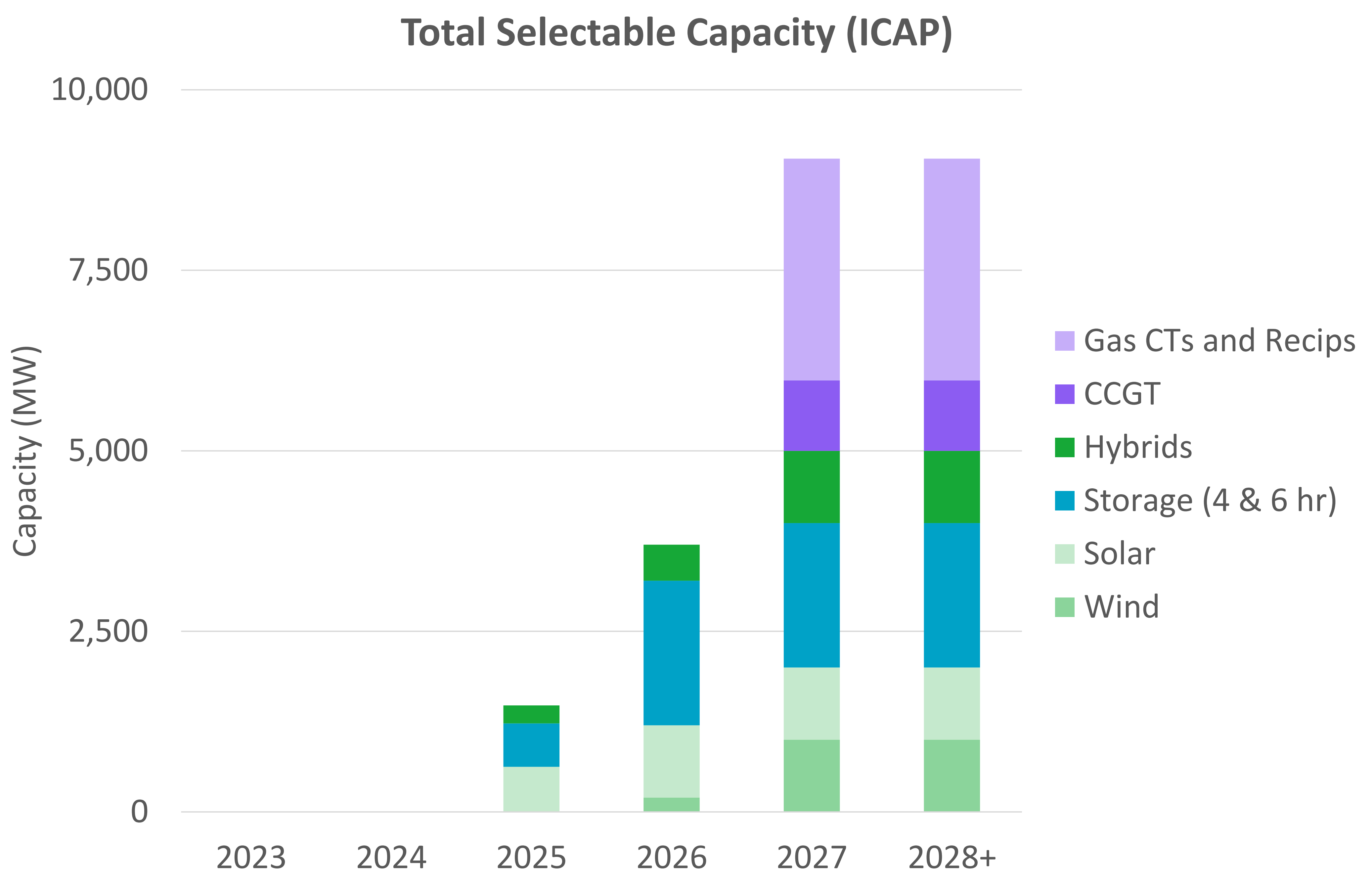
→ Selects a portfolio that covers at least 90% of AES Indiana's energy sales on an annual basis, limiting reliance on the market.

→ Also prevents a portfolio that sells more than 10% above AES Indiana's expected energy sales on an annual basis, limiting reliance on uncertain energy revenue. Excess generation is assumed to be curtailed.

# Model Constraints *(continued)*

## Limiting the Build of New Resources

- Prevents the model from selecting resources in the near term that cannot practically be executed and are not supported by recent RFP responses.
  - Earliest build is ~1,500 MW (ICAP) of Solar, Storage, and Hybrids in 2025
  - By 2027, can build ~1,000 MW (ICAP) of any technology per year
  - Over the 20-year time span, can build a max of ~2,000 MW of any one technology





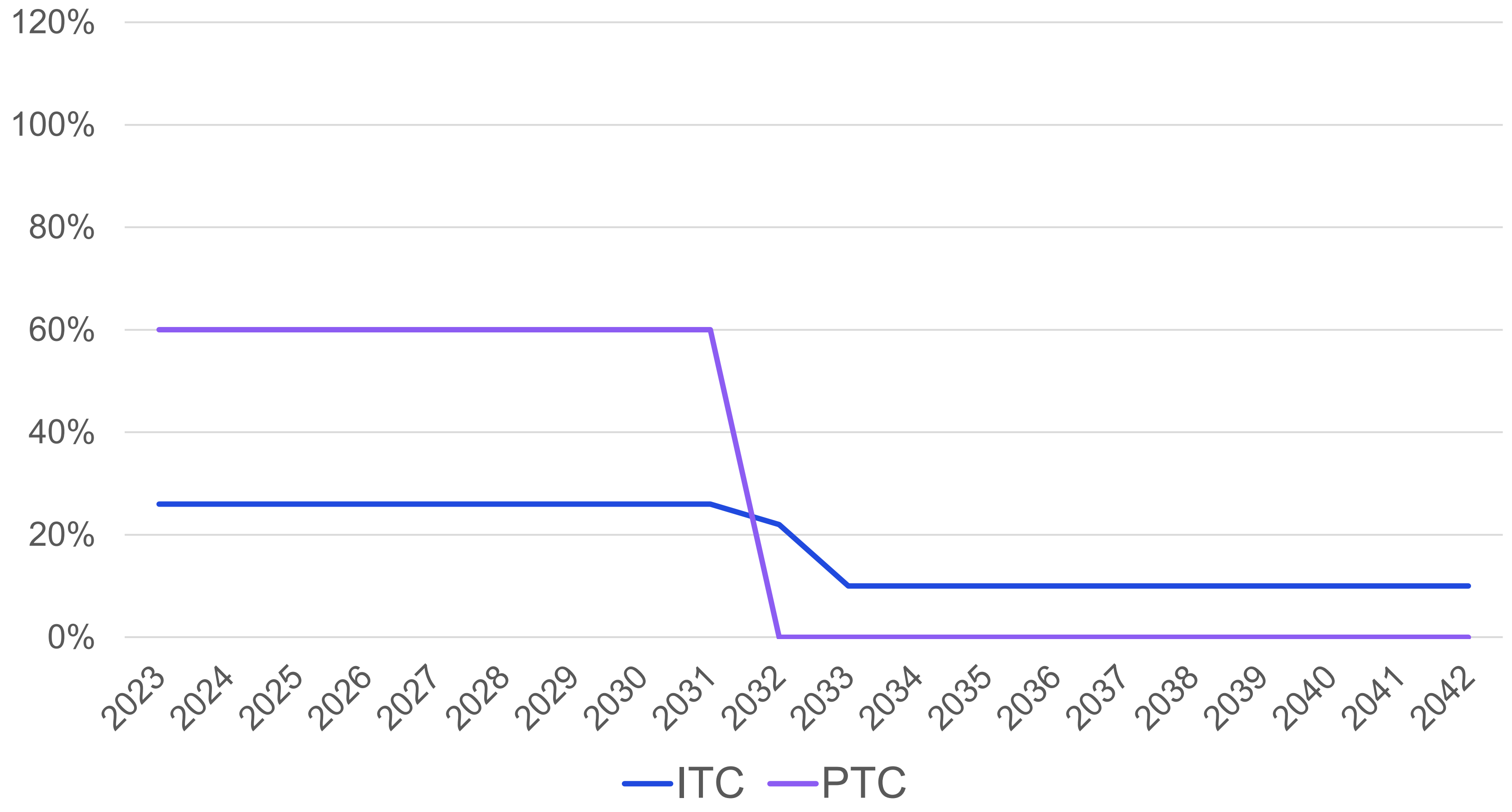

AES Indiana

# Modeling Updates

## Inflation Reduction Act of 2022 (IRA) included in Current Trends

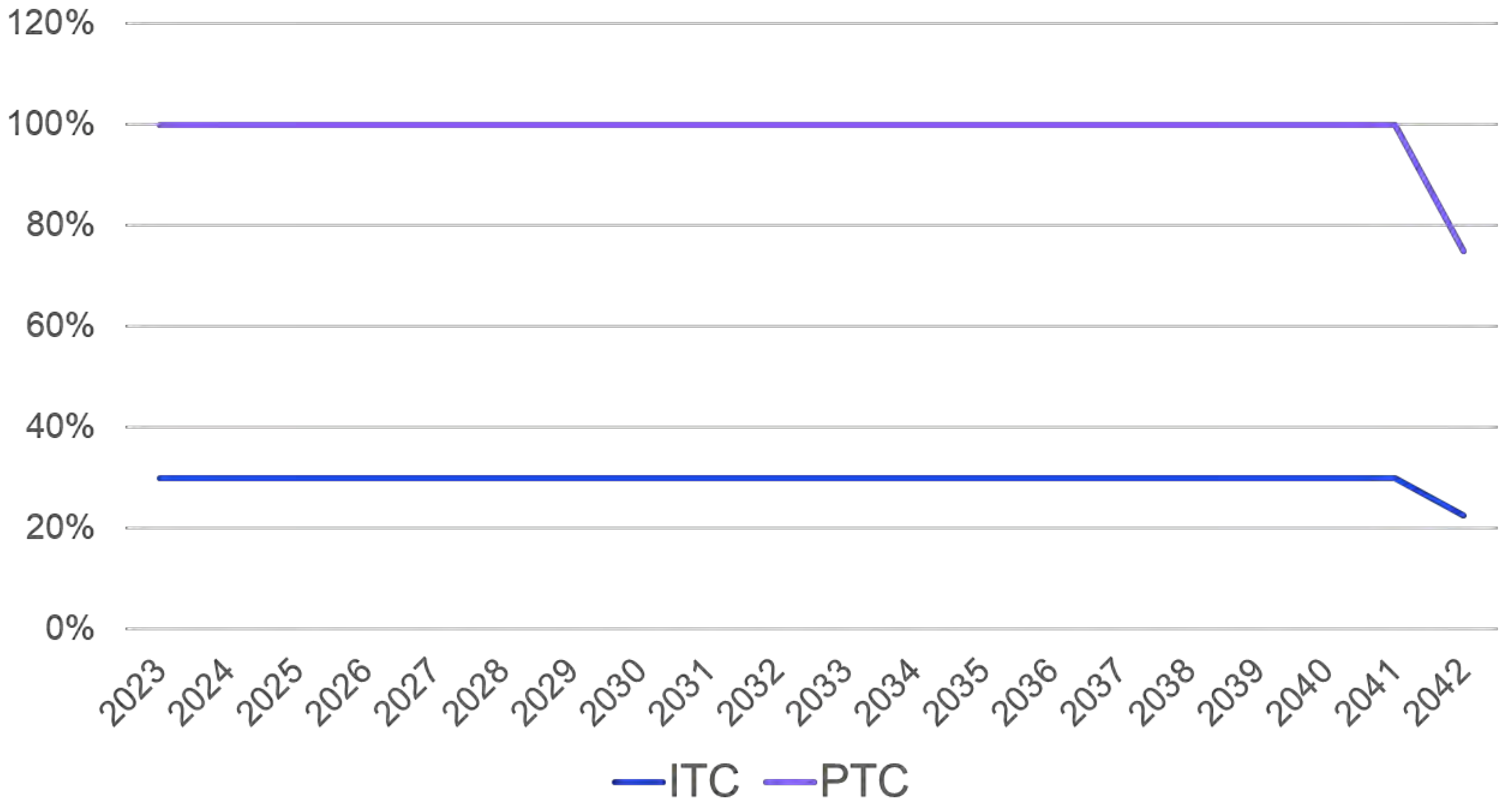
- IRA passed House and Senate and signed into law in August
- Legislation changes the Current Trends (Reference Case) assumptions for the ITC and PTC

**Original** – as presented in Public Advisory Meeting #2, April 12, 2022




**Original Current Trends** – Five one-year tax credit extensions

**Updated** – aligns with the IRA tax provisions



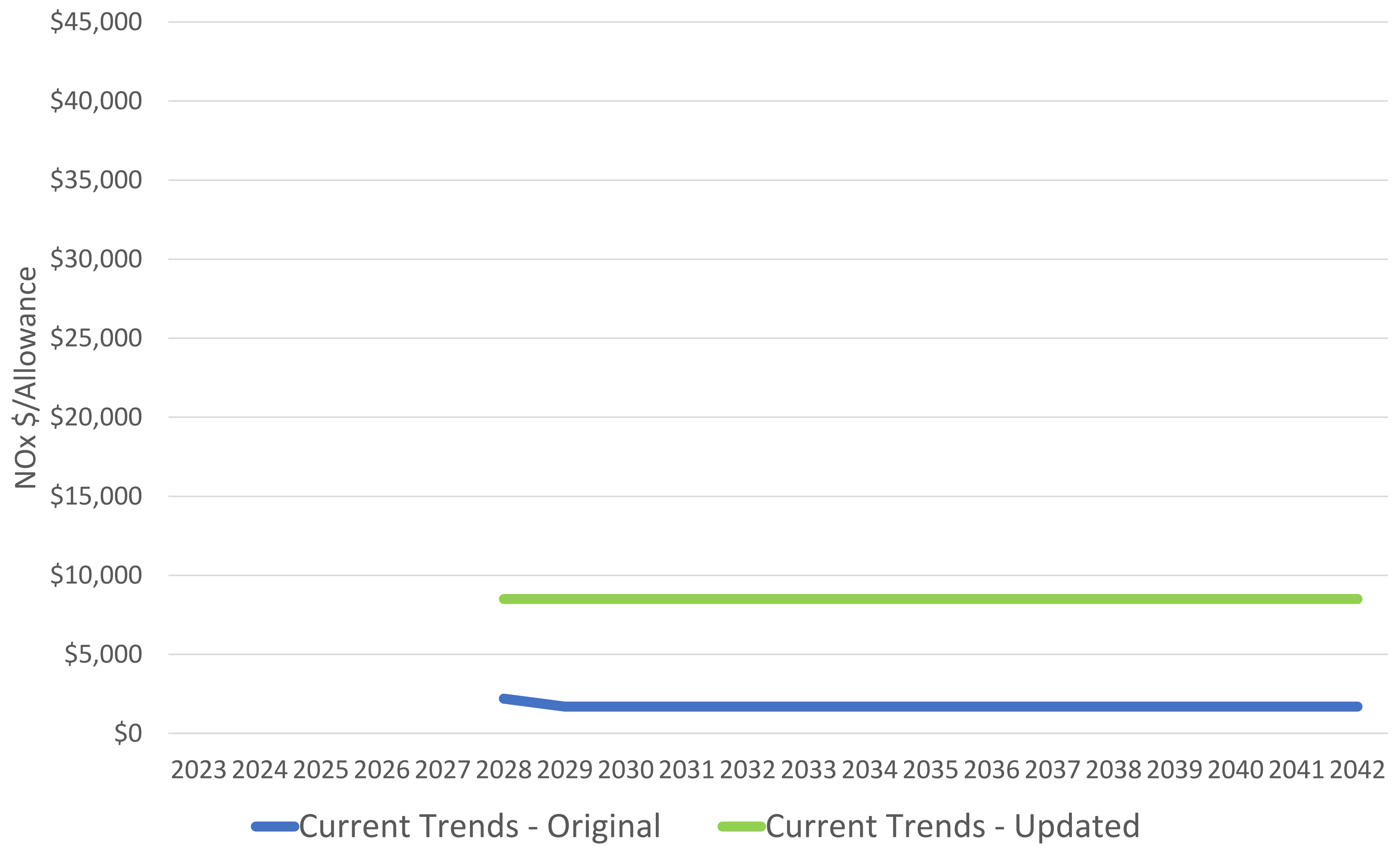

**Revised Current Trends** – Ten-year tax credit extension

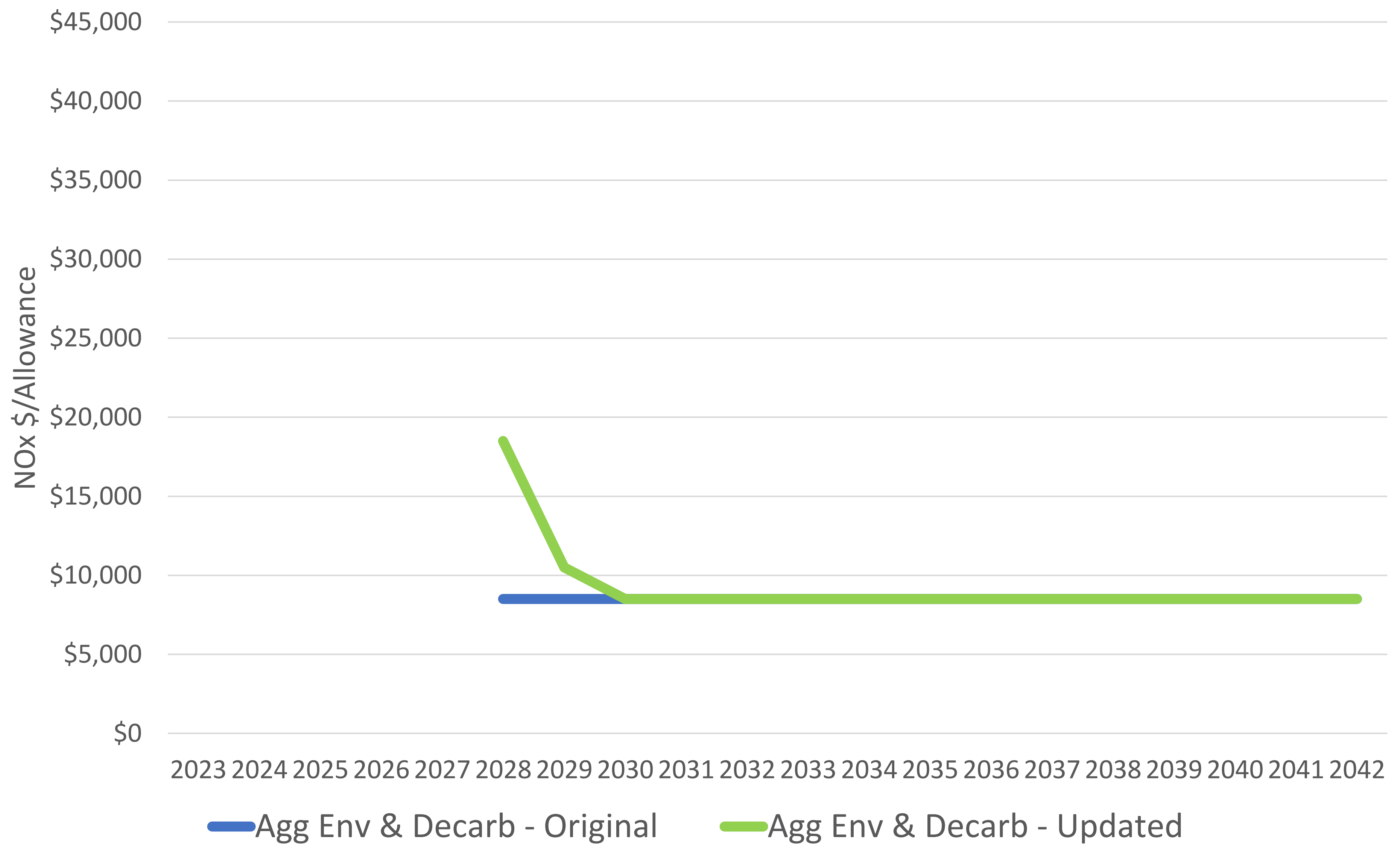
*Years correspond to years projects first produce energy

# Modeling Updates

## Forecast for NOx allowance prices updated based on current market trends

- Scarcity within the NOx allowance market has driven prices to historic highs
- Updated prices included in the Current Trends (Reference Case), Aggressive Environmental and Decarbonized Economy Scenarios



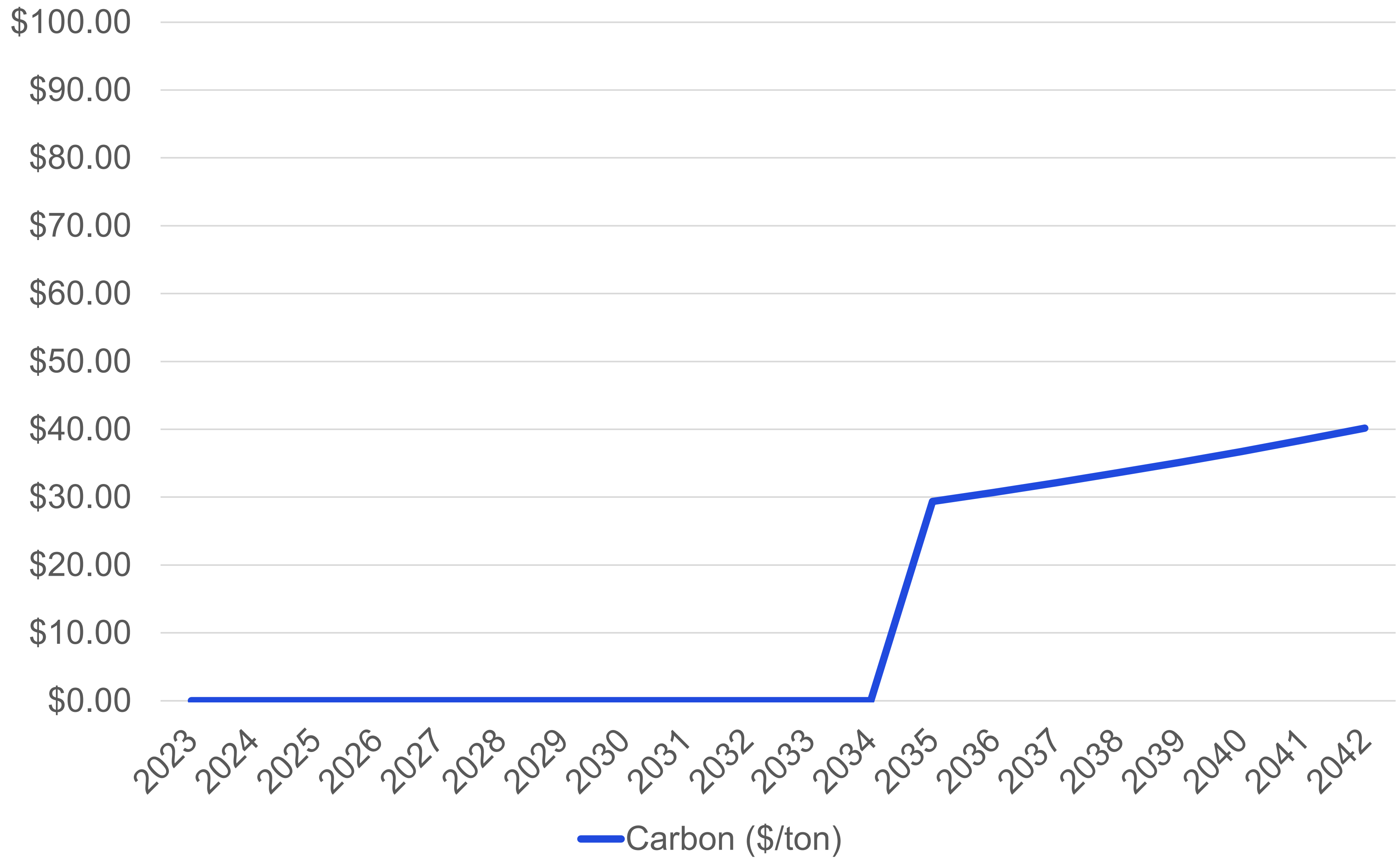


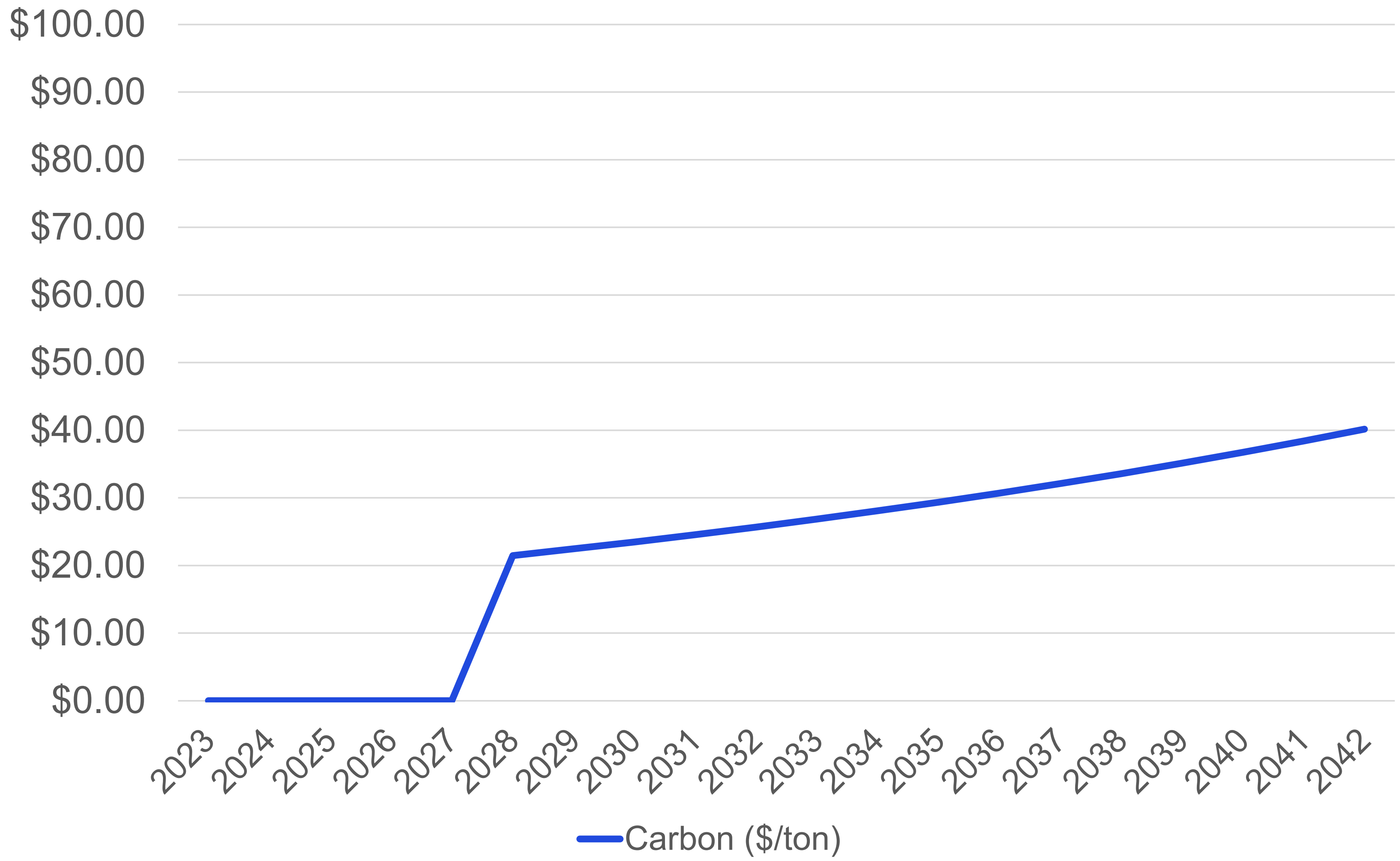

aes Indiana

# Modeling Updates

**Carbon Tax moved from starting in 2035 to starting in 2028 in the Aggressive Environmental Scenario**

- Change made to provide a reasonably aggressive environmental scenario
- Aligns with the Interagency Working Group Social Cost of Carbon Forecast (5% Discount Rate)

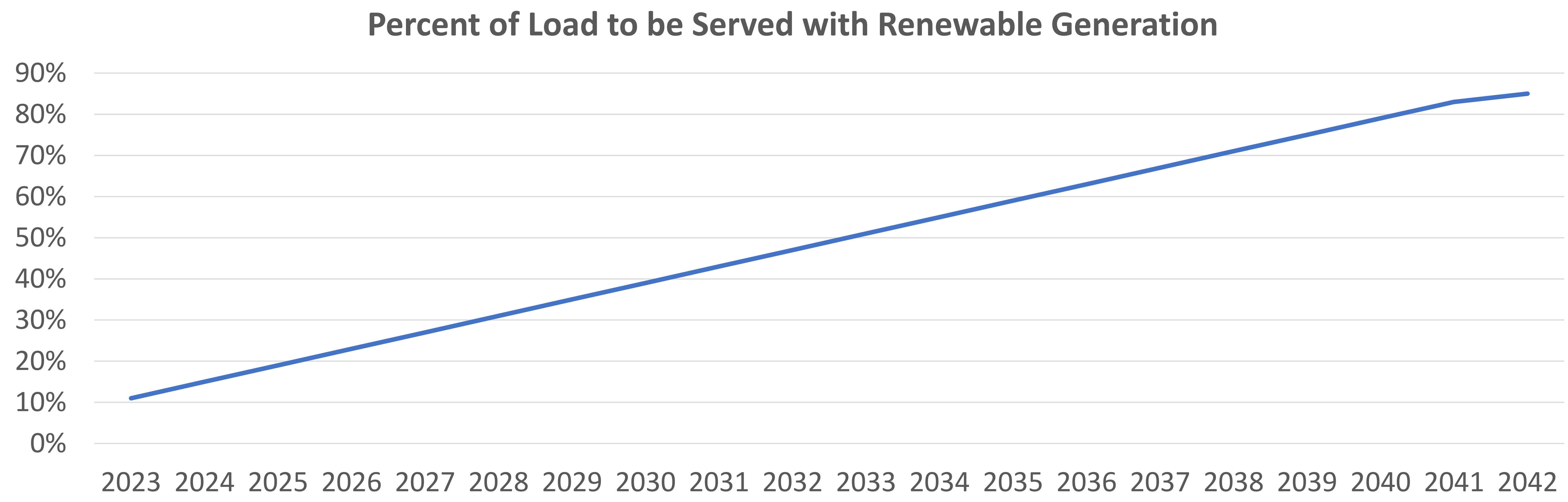



https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf

# Modeling the Decarbonized Economy Scenario

The Decarbonization Scenario captures a bookend with an aggressive grid transition to renewable energy generation. This is accomplished through a progressive Renewable Portfolio Standard (RPS):




RPS target, penalties, and grants are based on the theoretical Clean Energy Performance Program:

- → Failure to hit the RPS results in a $40/MWh penalty, per MWh of shortfall
- → Exceeding the RPS results in a $150/MWh grant, per MWh of exceedance



aes Indiana

# Structure for Today's Review

1 **Retirement & Replacement Analysis Review:** Review the optimized portfolios and complete the Portfolio Matrix

| | | Scenarios | | | |
|---|---|---|---|---|---|
| | | No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| Generation Strategies | **No Early Retirement** | | | | |
| | **Pete Refuel to 100% Gas (est. 2025)** | | | | |
| | **One Pete Unit Retires (2026)** | | | | |
| | **Both Pete Units Retire (2026 & 2028)** | | | | |
| | **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | | | | |
| | **Encompass Optimization without predefined Strategy** | | | | |

Portfolio cost (PVRR) will be calculated for each portfolio to complete Portfolio Matrix

- → Review generation mixes and PVRR in the Current Trends (Reference Case)
- → Complete the Portfolio Matrix and compare PVRR
- → Review the Replacement Resource Cost Sensitivity Analysis



aes Indiana

# Structure for Today's Review

## 2 Review key IRP Scorecard Metrics for the Current Trends (Reference Case)

| | 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*** | ***Cost Opportunity*** | ***Cost Risk*** | ***Market Exposure*** | ***Renewable Capital Cost Risk (+50%)*** | ***Employees (+/-)*** | ***Property Taxes*** |
| | Present Value of Revenue Requirements | 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 | Highest PVRR across policy scenarios | Mean - P95 | P95 - Mean | 20-year avg sales + purchases | Portfolio PVRR w/ renewable costs +50% | Total FTEs associated with generation | Total amount of property tax paid from AES IN assets |
| 1 | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | |

Calculations for each scoring metric will be included to complete the Scorecard

### 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

- Review PVRR, emissions and economic metrics
- **Reliability and risk analysis still in-progress and will be presented in Meeting #5**

# I. Retirement and Replacement Analysis Results

**Erik Miller**, Manager, Resource Planning, AES Indiana

# Capacity vs. Energy in Resource Planning

**These are two very different planning/market concepts.**

*1) Capacity Planning*

- MISO requires utilities to have enough generation resources to meet their peak hour plus a reserve margin (buffer). This is called a Planning Reserve Margin Requirement (PRMR).
- Historically, MISO planning has been based on only the summer peak hour + buffer/PRMR.
- This changed earlier in the month when FERC approved MISO's seasonal construct – **Utilities now are required to have enough generation to serve their peak hour + buffer/PRMR in all four seasons – summer, fall, winter and spring.**
- With the seasonal construct, AES Indiana now has a higher winter peak hour + buffer/PRMR than summer.
- There's a market for capacity – thus, AES Indiana assigns a monetary value to capacity for modeling purposes - $89/kW-yr.


AES Indiana

# Capacity vs. Energy in Resource Planning cont'd

*2) Energy Planning*

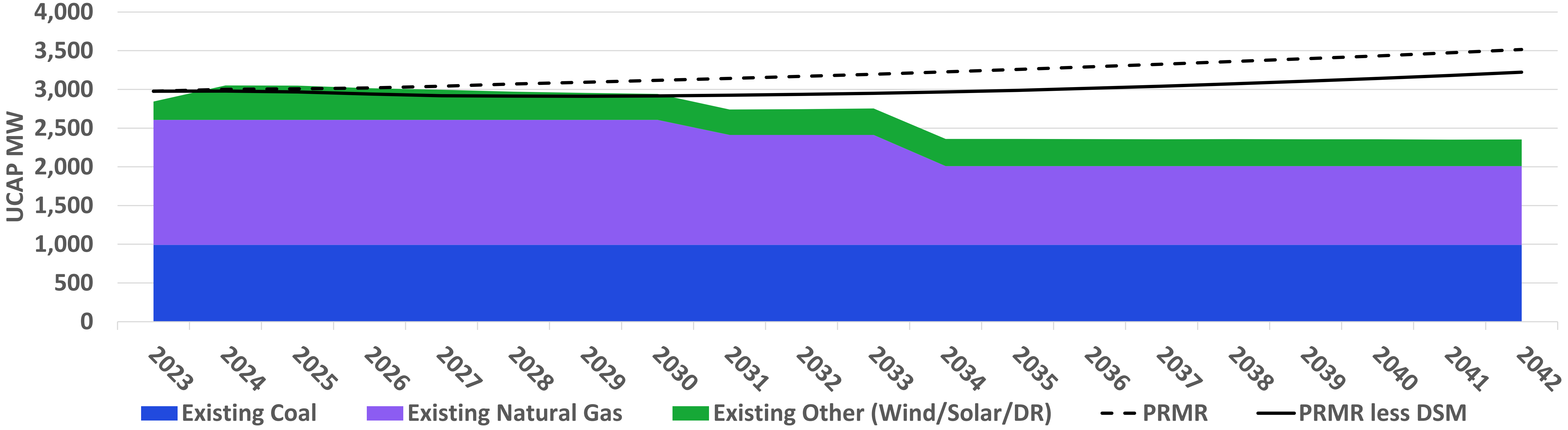
- Most people are familiar with energy – this is a MWh that is produced or purchased to supply customers.
- For planning purposes, AES Indiana can build generation to supply energy for its customers or rely on the market. Relying on the market for energy comes with both price and reliability risks to customers.
- **Energy planning is where we can really make an impact on emissions.**

*Differences in Resource Types*

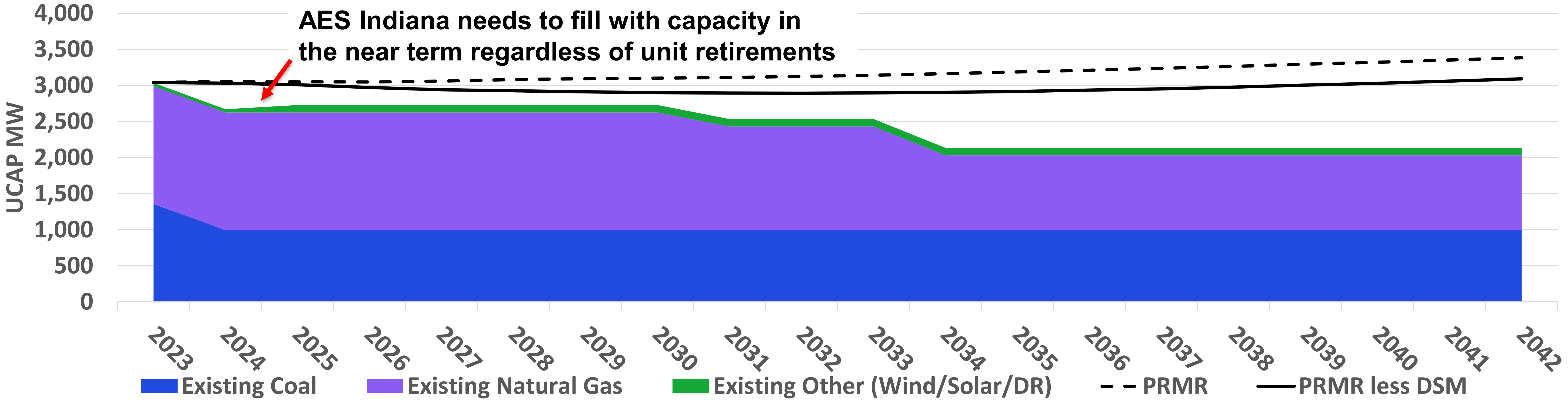
- Certain resources are better suited for supplying <u>capacity</u> –
  - Thermal and battery energy storage resources are dispatchable – therefore, MISO gives them almost full credit as a capacity resource in all seasons.
  - Wind and solar are not dispatchable (utilities can't control when they are on) – therefore, MISO correspondingly adjusts down their capacity value, e.g. a 200 MW solar resource receives zero capacity value (ELCC) in the winter.
  - A resource can be built for its <u>capacity</u> value and run very little to supply <u>energy</u>. **It's there when the system really needs it!**

# Summer vs. Winter Capacity Position

Summer Capacity Position – "Status Quo"




Winter Capacity Position – "Status Quo"




Historically, AES Indiana has only had to plan for its summer peak + buffer/PRMR.

This changed in early September when FERC approved MISO's four-season capacity construct.

AES has a winter capacity shortage in the near-term regardless of unit retirements.

Unfortunately, based on MISO's accreditation, solar receives no value in the winter and wind receives only 18% of it's full value.

The planning model can only select thermal or battery energy storage resources to fill this winter capacity need. Solar can be combined with battery energy storage if economic.

aes Indiana

# Summary of Scenario Driving Assumptions

| Scenario | Load | EV | Dist Solar | Power | Gas | Coal | CO2 |
|---|---|---|---|---|---|---|---|
| **No Environmental Action – "No Env"** | Low | Low | Low | Horizon Fundamental Forecast | Low | Base | None |
| **Current Trends (Reference Case) – "Ref"** | Base | Base | Base | Horizon Fundamental Forecast | Base | Base | Low |
| **Aggressive Environmental – "AE"** | High | High | High | Horizon Fundamental Forecast | High | Base | High |
| **Decarbonized Economy – "Decarb"** | High | Very High | High | Horizon Fundamental Forecast | Base | Base | None* |

*Carbon targets will be modeled through a National Renewable Portfolio Standard

# Current Trends Assumptions Review

The following slides provide the **Portfolio Summaries for the Current Trends Scenario – these are the candidate portfolios**. Portfolio Summaries will include the following:

- Generation mix and Unforced Capacity position
- Installed capacity over the planning period
- % energy mix to serve load
- DSM Selections
- PVRR

As a review, the **Current Trends Scenario** includes the **following driving assumptions**:

- Base Power, Gas, and Coal Prices
- Base NOx Prices
- ITC & PTC assumptions aligned with the Inflation Reduction Act
- Low Carbon Price at $6.49/ton starting in 2028 and escalating annually at 4.6%
- Base load, EV and customer solar forecasts

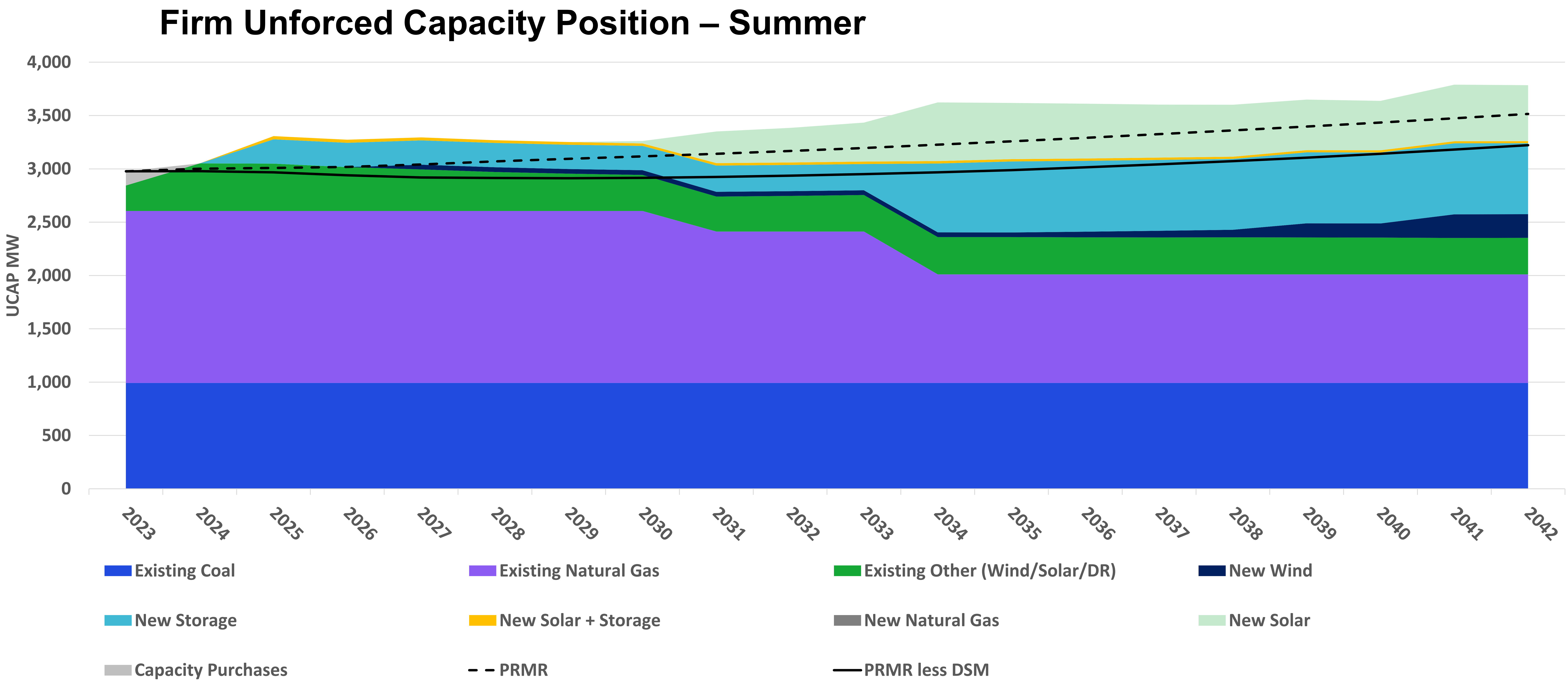
This section will conclude with a comparison of the PVRRs for the Strategies and Scenarios in the Portfolio Matrix.

Note: The Portfolio Summaries for the No Environmental Action, Aggressive Environmental and Decarbonized Economy scenarios are included in the appendix of this presentation.

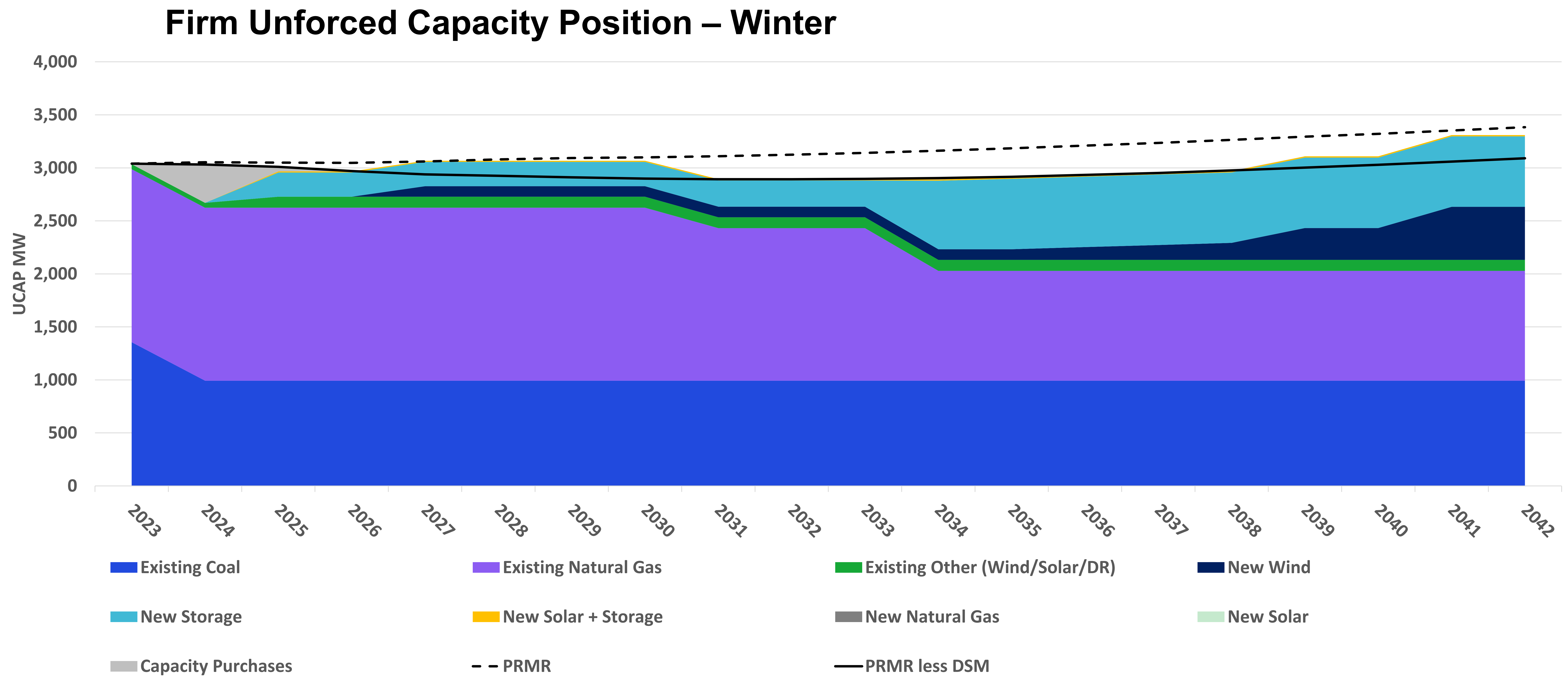
# A. No Early Retirement

| Scenarios | | | |
| --- | --- | --- | --- |
| No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| | $9,572 | | |

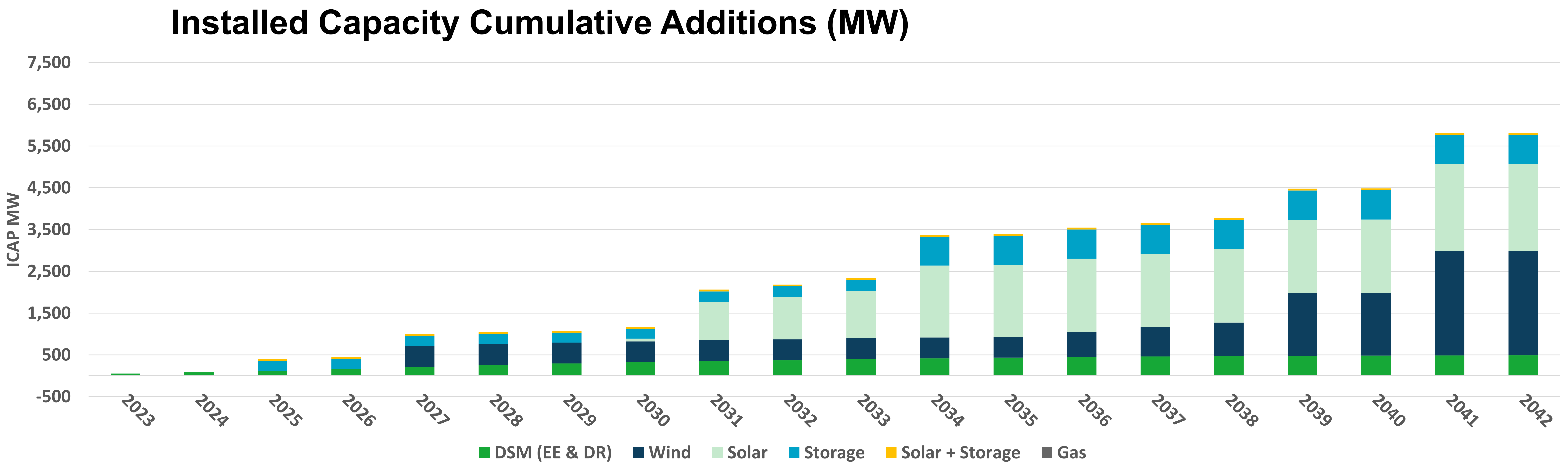
# No Early Retirement: Current Trends *(Reference Case)*



# No Early Retirement: Current Trends *(Reference Case)*



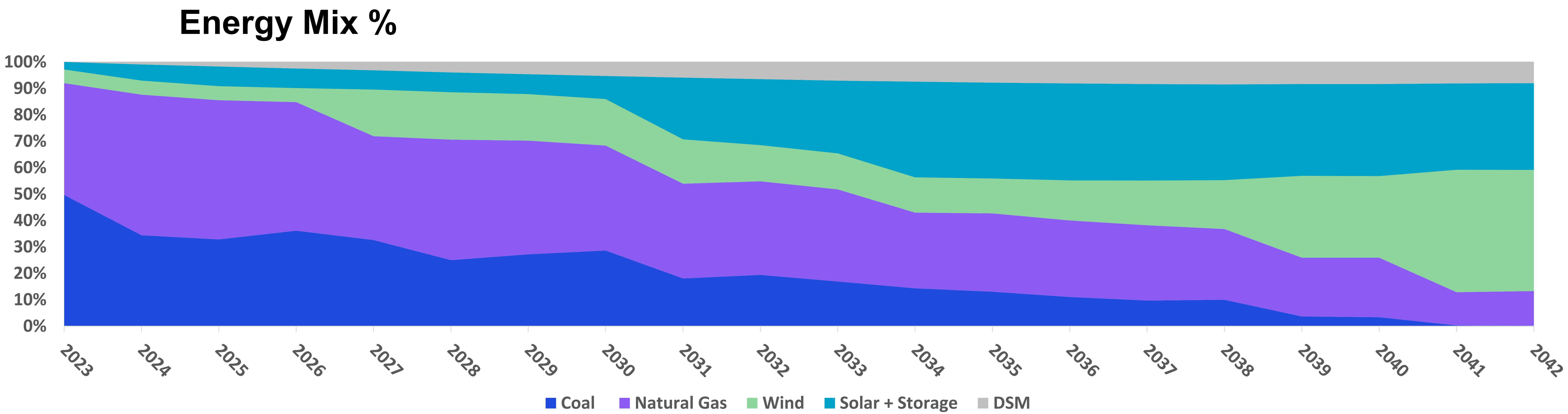
# No Early Retirement: Current Trends *(Reference Case)*

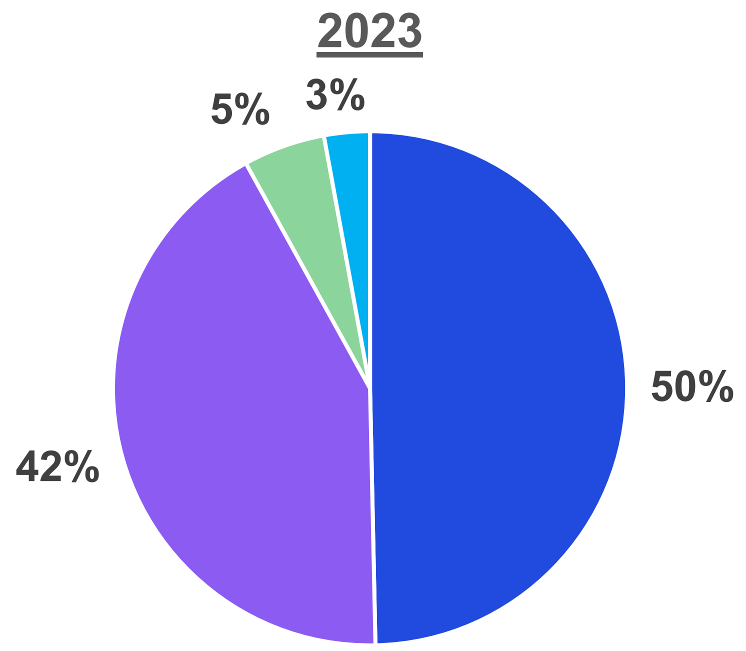



***Installed Capacity Incremental Additions (MW): 2023 - 2028***

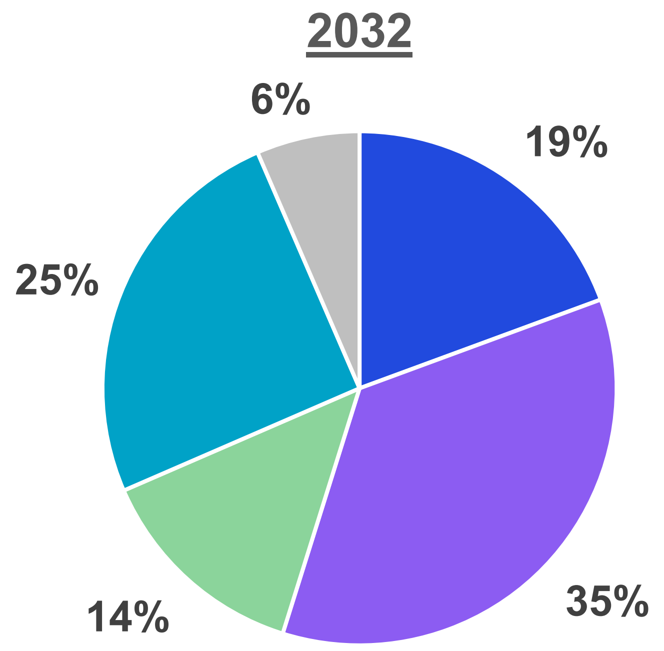
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 0 | 500 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 240 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Natural Gas | 0 | 0 | 0 | 0 | 0 | 0 |

# No Early Retirement: Current Trends *(Reference Case)*

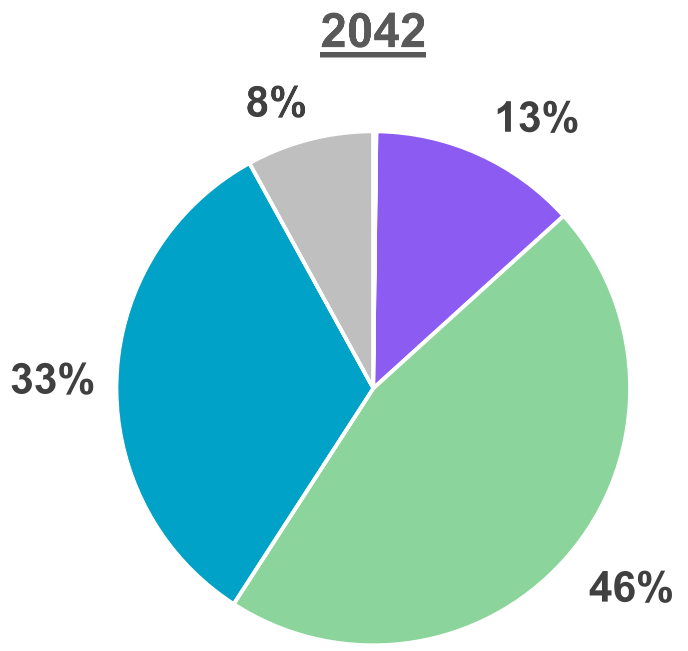



| | |
|---|---|
| Thermal MWh % | 92% |
| Renewable/DSM MWh % | 8% |




| | |
|---|---|
| Thermal MWh % | 55% |
| Renewable/DSM MWh % | 45% |




| | |
|---|---|
| Thermal MWh % | 13% |
| Renewable/DSM MWh % | 87% |



aes Indiana

# No Early Retirement: Current Trends *(Reference Case)*

## DSM Results

### *Energy Efficiency:*

| | Vintage 1<br>2024 - 2026 | Vintage 2<br>2027 - 2029 | Vintage 3<br>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 |
| | 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% | 1.2% |
| | Cummulative Summer MW | Cummulative Summer MW | Cummulative Summer MW |
| | 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



aes Indiana

# No Early Retirement: Current Trends *(Reference Case)*

## Portfolio Overview

### *Retirements*

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 490 MW
- Wind: 2,500 MW
- Solar: 2,080 MW
- Storage: 700 MW
- Solar + Storage: 45 MW
- Thermal: 0 MW

**Current Trends PVRR Summary**

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

| Strategy | PVRR |
|---|---|
| **No Early Retirement** | $9,572 |
| **Pete Refuel to 100% Gas (est. 2025)** | $9,330 |
| **One Pete Unit Retires (2026)** | $9,773 |
| **Both Pete Units Retire (2026 & 2028)** | $9,618 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,711 |
| **Encompass Optimization without predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027** | $9,262 |

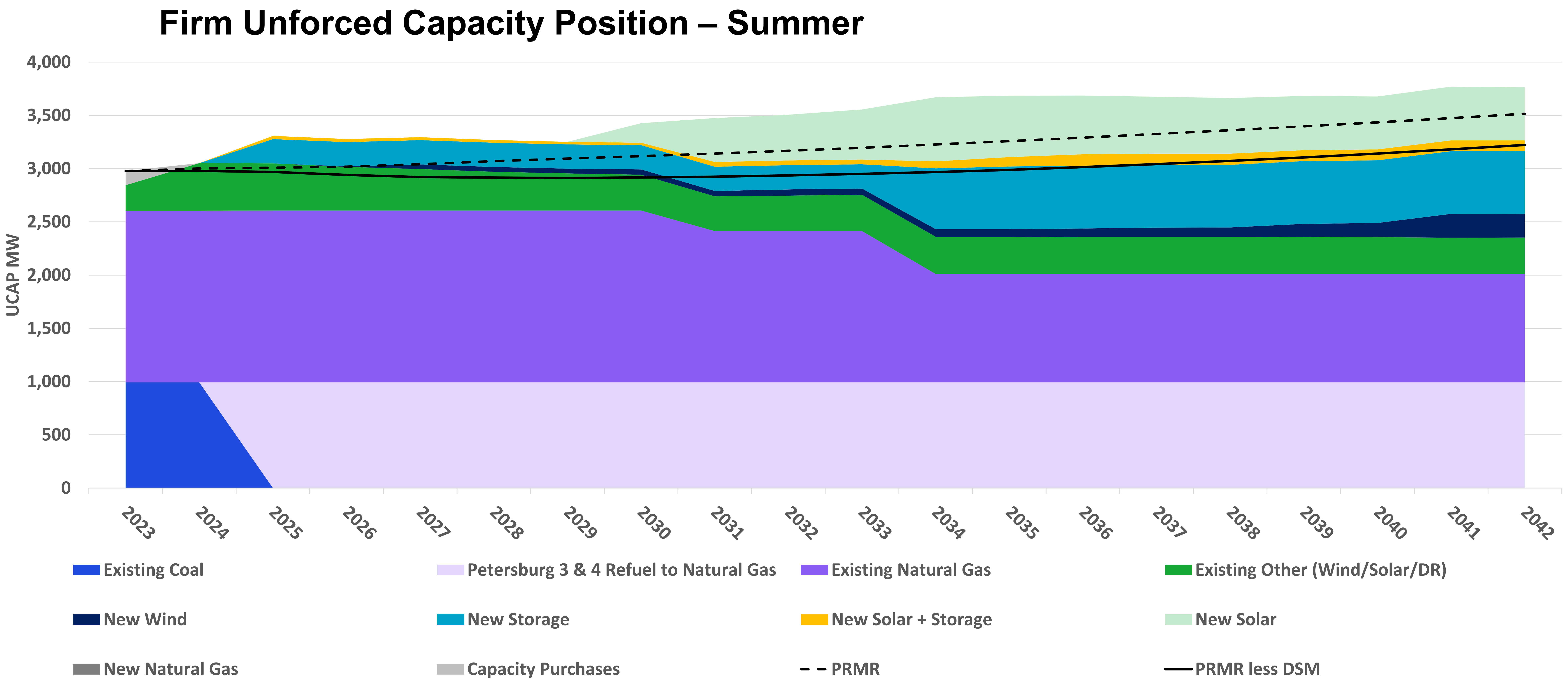


aes Indiana

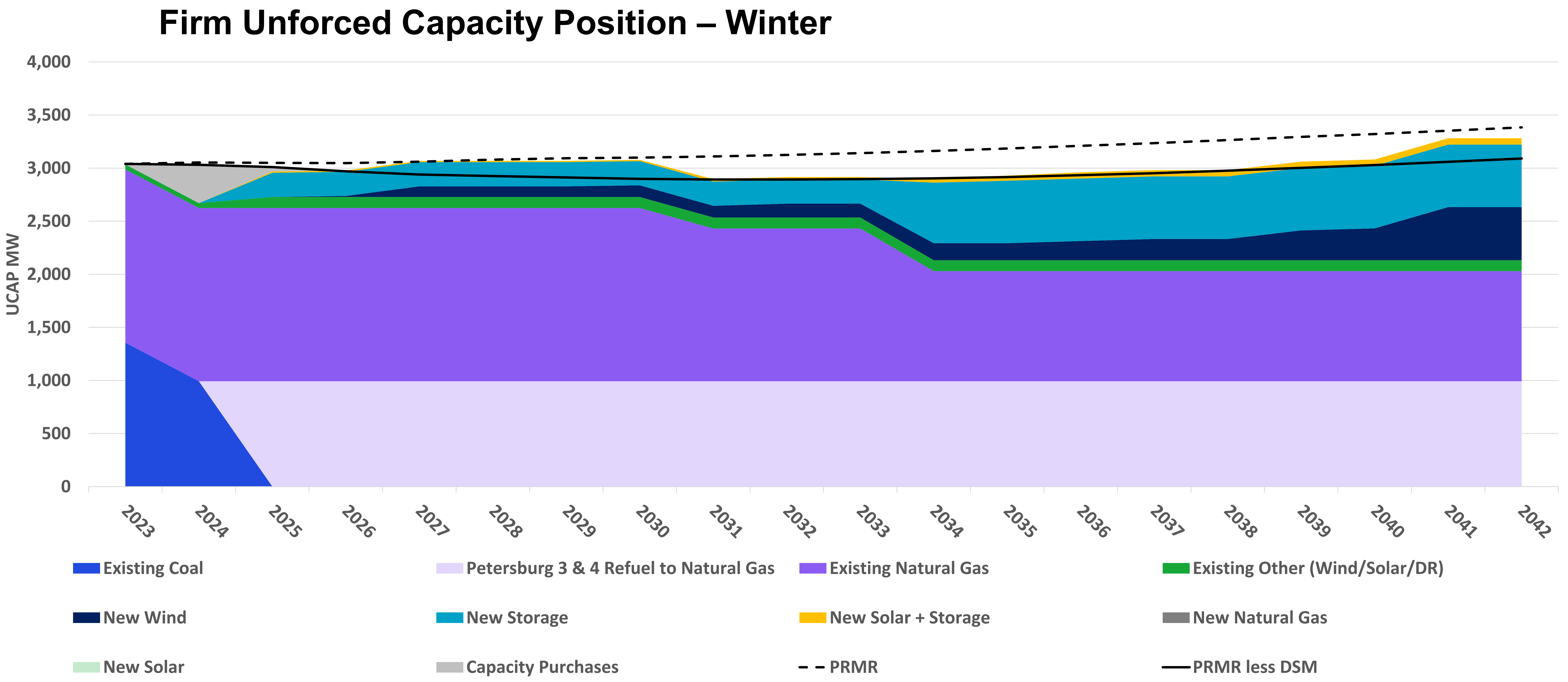
# B. Pete Refuel by 2025

| Scenarios | | | |
|---|---|---|---|
| No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| | $9,330 | | |

# Pete 3 & 4 Refuel in 2025: Current Trends *(Reference Case)*



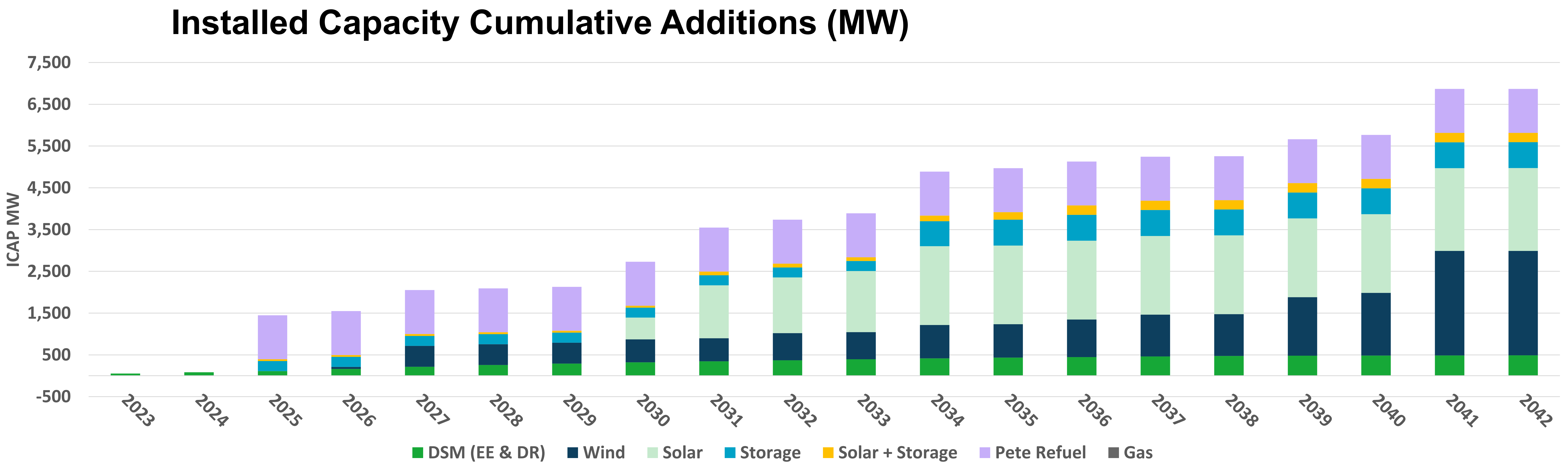
# Pete 3 & 4 Refuel in 2025: Current Trends *(Reference Case)*






AES Indiana

# Pete 3 & 4 Refuel in 2025: Current Trends *(Reference Case)*




***Installed Capacity Incremental Additions (MW): 2023 - 2028***

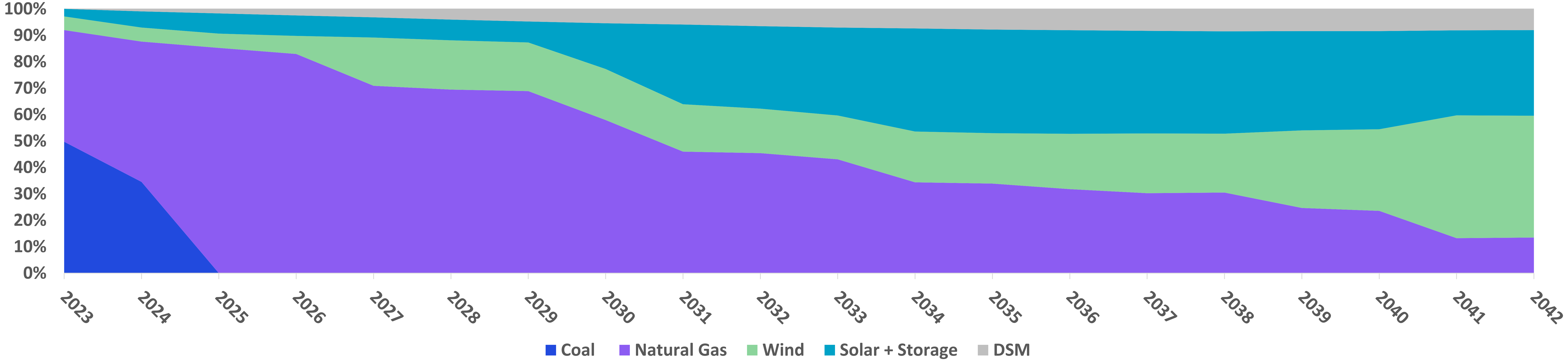
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Pete Refuel | 0 | 0 | 1,052 | 0 | 0 | 0 |
| Wind | 0 | 0 | 0 | 50 | 450 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 240 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Natural Gas | 0 | 0 | 0 | 0 | 0 | 0 |

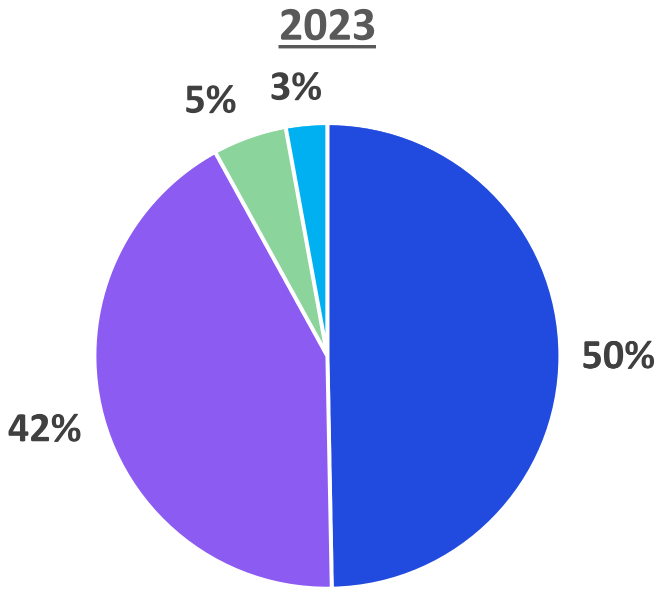


aes Indiana

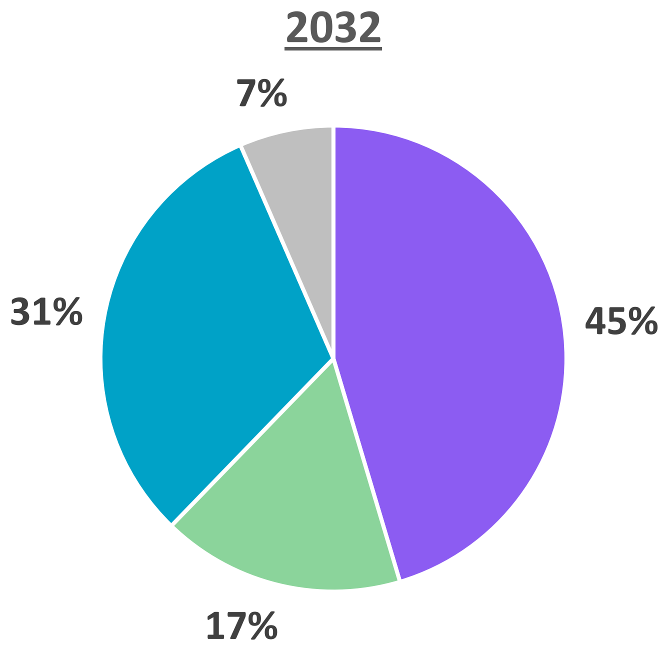
# Pete 3 & 4 Refuel in 2025: Current Trends *(Reference Case)*

## Energy Mix %

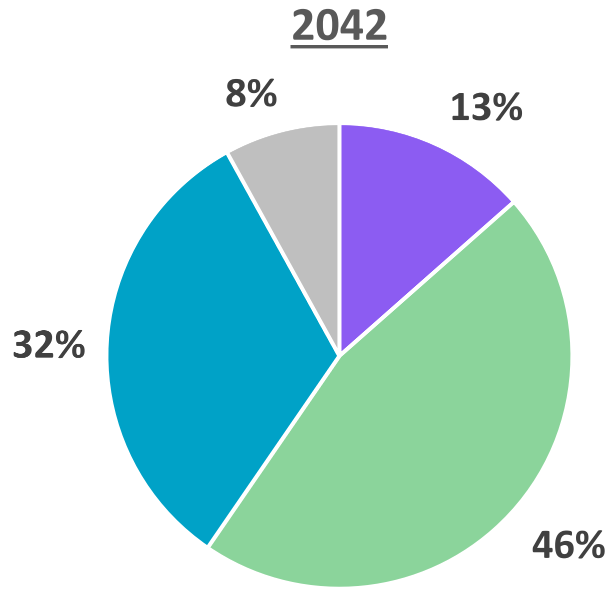



| | |
|---|---|
| Thermal MWh % | 92% |
| Renewable/DSM MWh % | 8% |




| | |
|---|---|
| Thermal MWh % | 45% |
| Renewable/DSM MWh % | 55% |




| | |
|---|---|
| Thermal MWh % | 13% |
| Renewable/DSM MWh % | 87% |



aes Indiana

# Pete 3 & 4 Refuel in 2025: Current Trends *(Reference Case)*

## DSM Results

### *Energy Efficiency:*

| | Vintage 1 | Vintage 2 | Vintage 3 |
|---|---|---|---|
| | 2024 - 2026 | 2027 - 2029 | 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 | 141,526 | 146,428 |
| | % of 2021 Sales ex. Opt-Out | % of 2021 Sales ex. Opt-Out | % of 2021 Sales ex. Opt-Out |
| | 1.0% | 1.1% | 1.2% |
| | Cumulative Summer MW | Cumulative Summer MW | Cumulative Summer MW |
| | 87 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

# Pete 3 & 4 Refuel in 2025: Current Trends *(Reference Case)*

## Portfolio Overview

### *Retirements*

Petersburg:

- Pete 3 & 4 Coal: 2025 Refuel with Nat Gas
  - **Total Refueled MW: 1,040 MW**

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 490 MW
- Wind: 2,500 MW
- Solar: 1,983 MW
- Storage: 620 MW
- Solar + Storage: 225 MW
- Thermal: 0
- Pete 3 & 4 Refueled to Nat Gas: 1,000 MW

**Current Trends PVRR Summary**

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

| Strategy | PVRR |
|---|---|
| **No Early Retirement** | $9,572 |
| **Pete Refuel to 100% Gas (est. 2025)** | $9,330 |
| **One Pete Unit Retires (2026)** | $9,773 |
| **Both Pete Units Retire (2026 & 2028)** | $9,618 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,711 |
| **Encompass Optimization without predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027** | $9,262 |

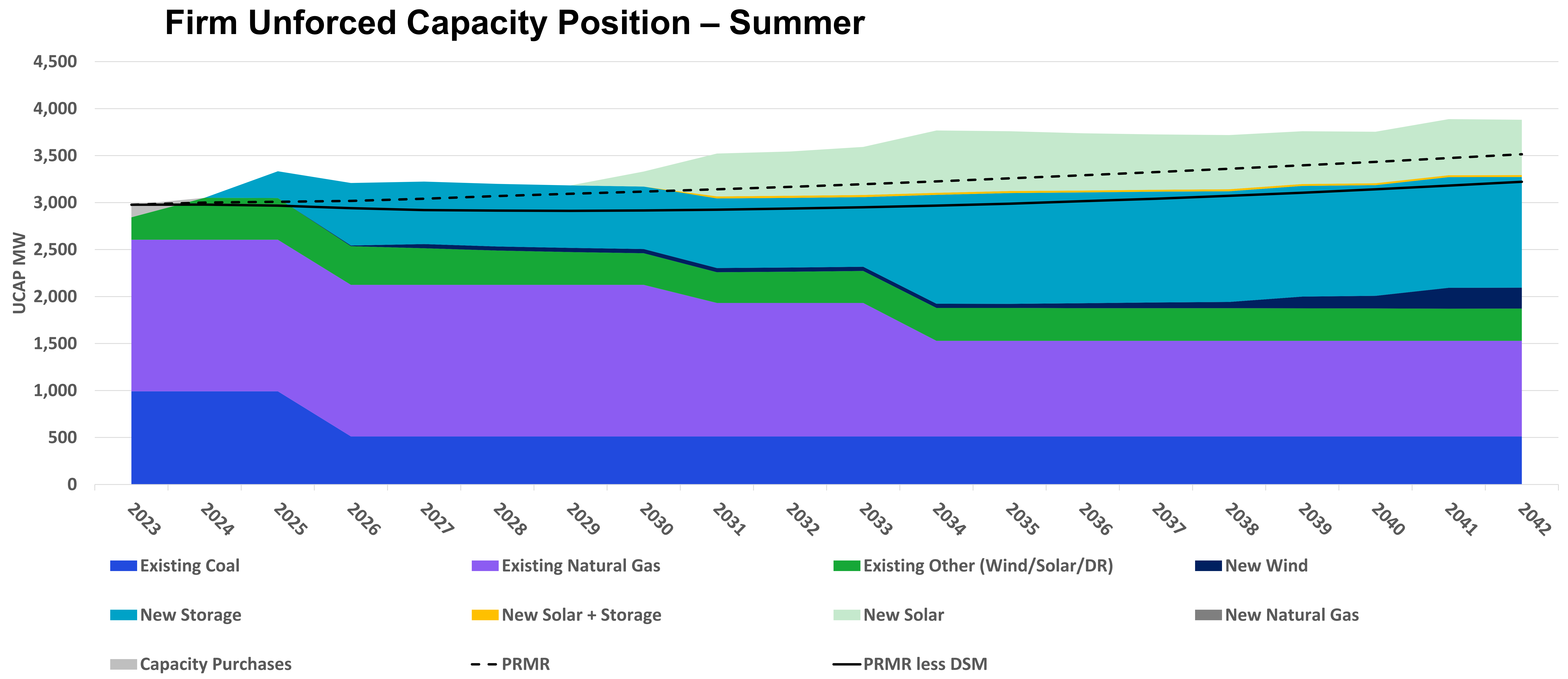


AES Indiana

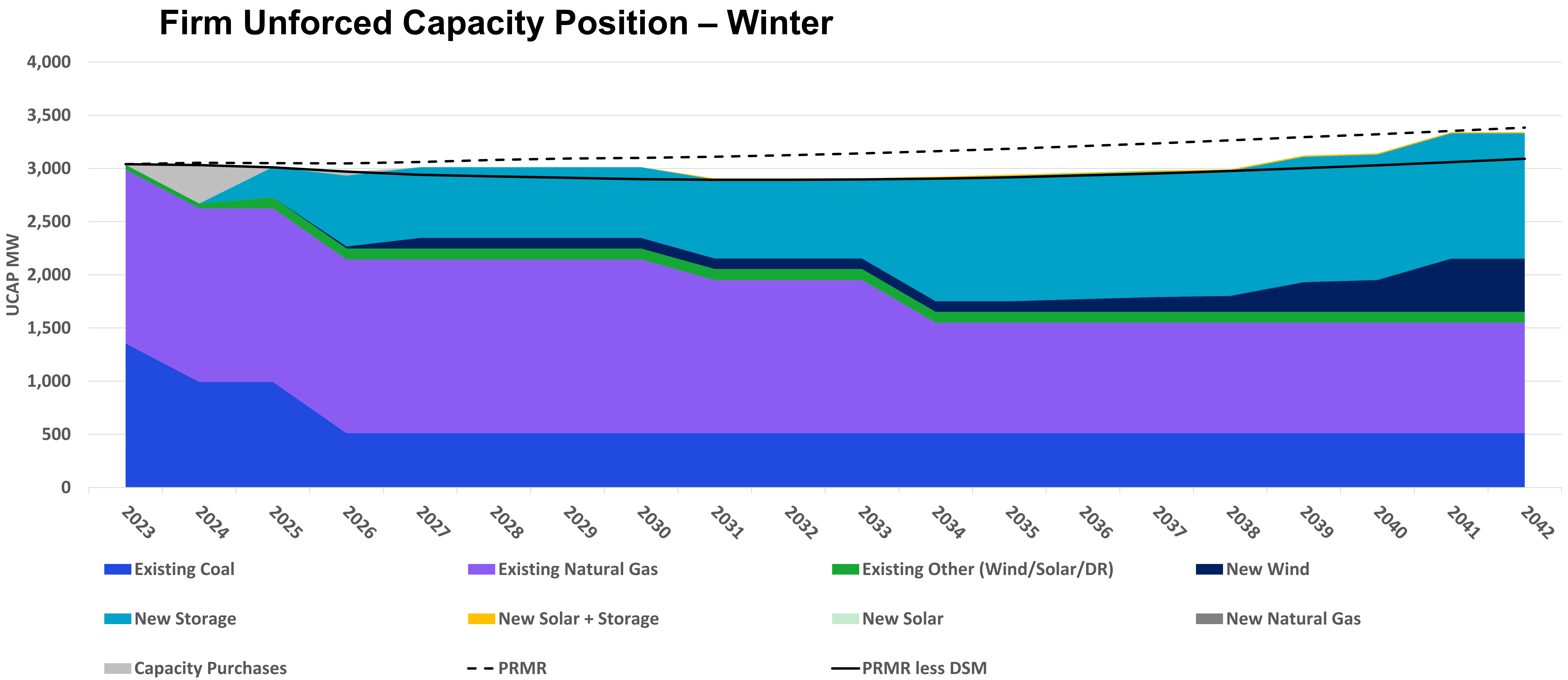
# C. One Pete Unit Retires (2026)

| Scenarios | | | |
|---|---|---|---|
| No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| | $9,773 | | |

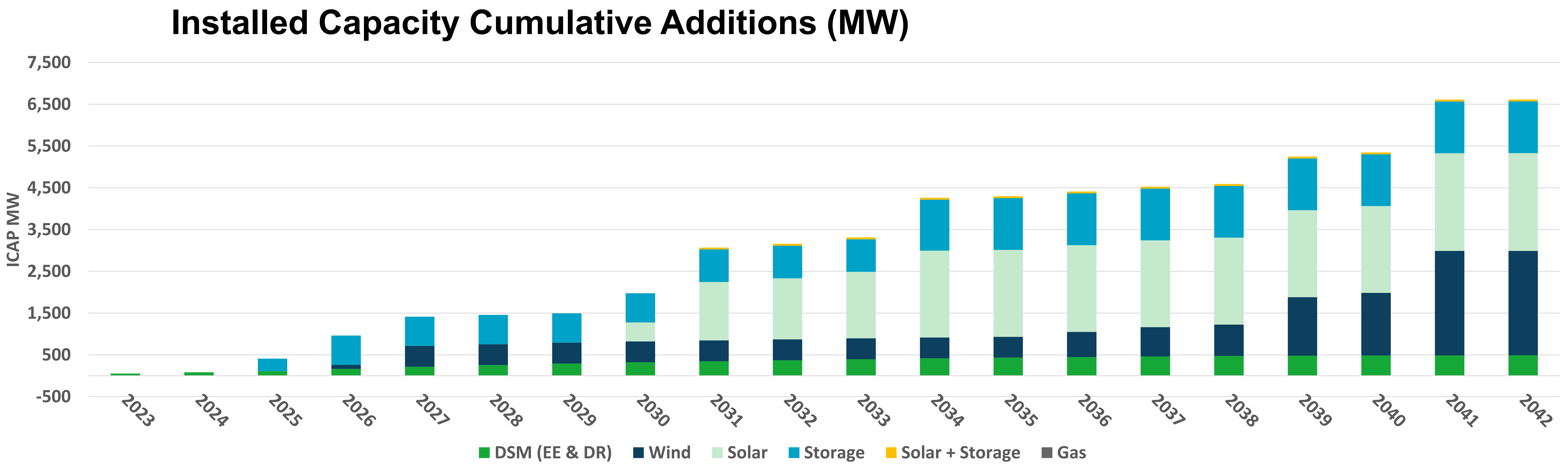
# One Pete Unit Retires (2026): Current Trends *(Reference Case)*



# One Pete Unit Retires (2026): Current Trends *(Reference Case)*



# One Pete Unit Retires (2026): Current Trends *(Reference Case)*



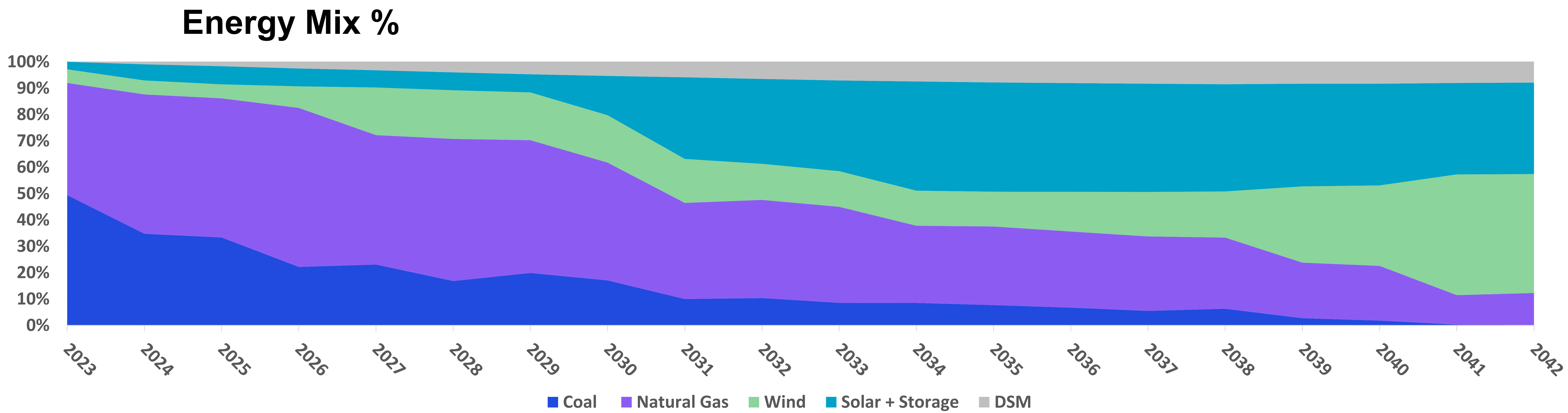

***Installed Capacity Incremental Additions (MW): 2023 - 2028***

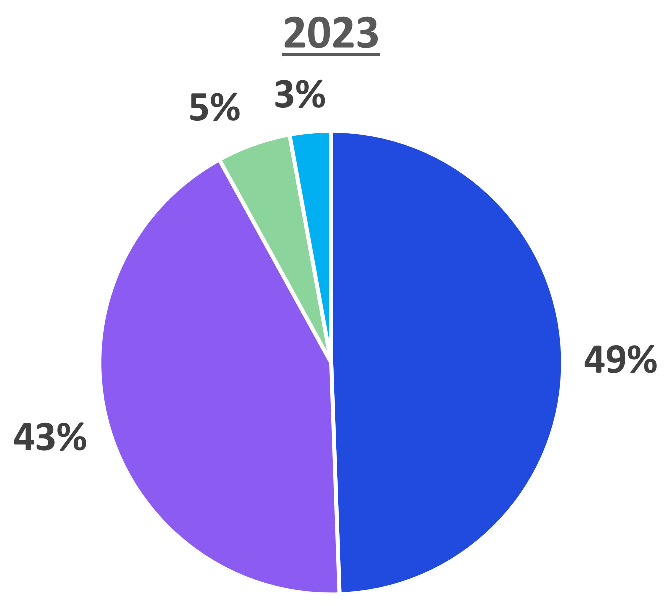
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 100 | 400 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 300 | 400 | 0 | 0 |
| Solar + Storage | 0 | 0 | 0 | 0 | 0 | 0 |
| Natural Gas | 0 | 0 | 0 | 0 | 0 | 0 |

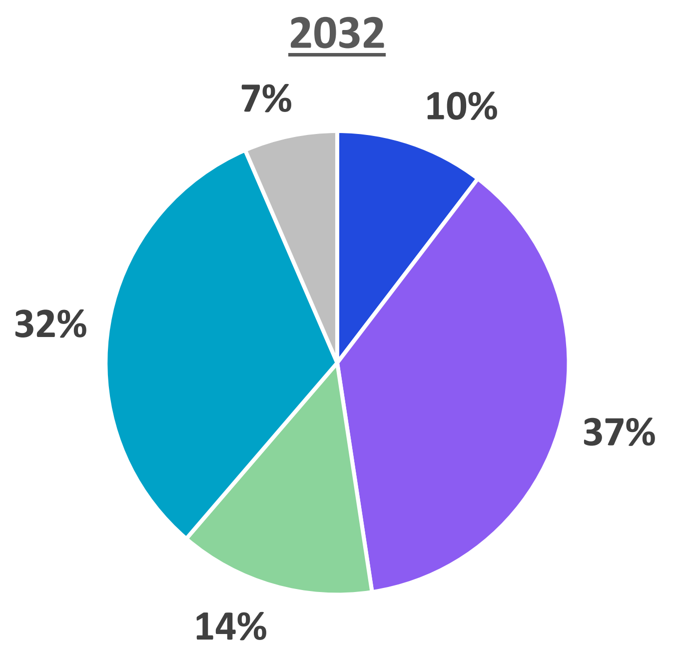


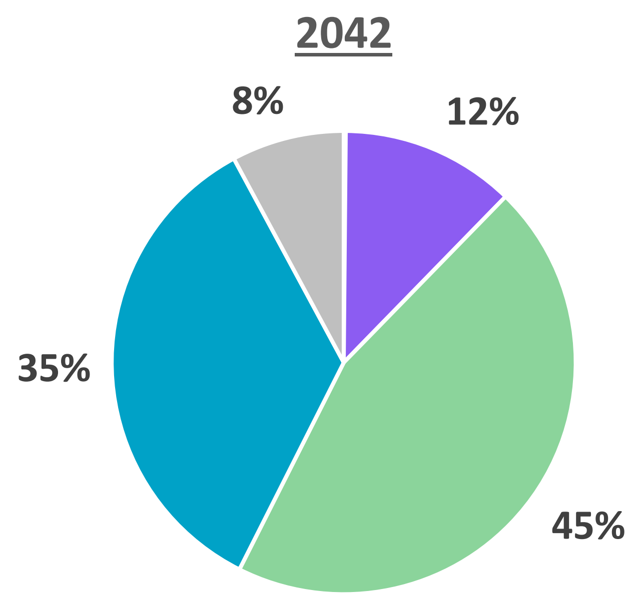
aes Indiana

# One Pete Unit Retires (2026): Current Trends *(Reference Case)*




| | |
|---|---|
| Thermal MWh % | 92% |
| Renewable/DSM MWh % | 8% |

| | |
|---|---|
| Thermal MWh % | 48% |
| Renewable/DSM MWh % | 52% |

| | |
|---|---|
| Thermal MWh % | 12% |
| Renewable/DSM MWh % | 88% |

# One Pete Unit Retires (2026): Current Trends *(Reference Case)*

## DSM Results

### *Energy Efficiency:*

| | Vintage 1 | Vintage 2 | Vintage 3 |
|---|---|---|---|
| | 2024 - 2026 | 2027 - 2029 | 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 | 141,526 | 146,428 |
| | % of 2021 Sales ex. Opt-Out | % of 2021 Sales ex. Opt-Out | % of 2021 Sales ex. Opt-Out |
| | 1.0% | 1.1% | 1.2% |
| | Cummulative Summer MW | Cummulative Summer MW | Cummulative Summer MW |
| | 87 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



aes Indiana

# One Pete Unit Retires (2026): Current Trends *(Reference Case)*

## Portfolio Overview

### *Retirements*

Petersburg:

- Pete 3 Coal: 2026
  - **Total Coal Retired MW: 520 MW**

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 490 MW
- Wind: 2,500 MW
- Solar: 2,340 MW
- Storage: 1,240 MW
- Solar + Storage: 45 MW
- Thermal: 0 MW

**Current Trends PVRR Summary**

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

| Strategy | PVRR |
|---|---|
| No Early Retirement | $9,572 |
| Pete Refuel to 100% Gas (est. 2025) | $9,330 |
| One Pete Unit Retires (2026) | $9,773 |
| Both Pete Units Retire (2026 & 2028) | $9,618 |
| "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | $9,711 |
| Encompass Optimization without predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027 | $9,262 |



AES Indiana

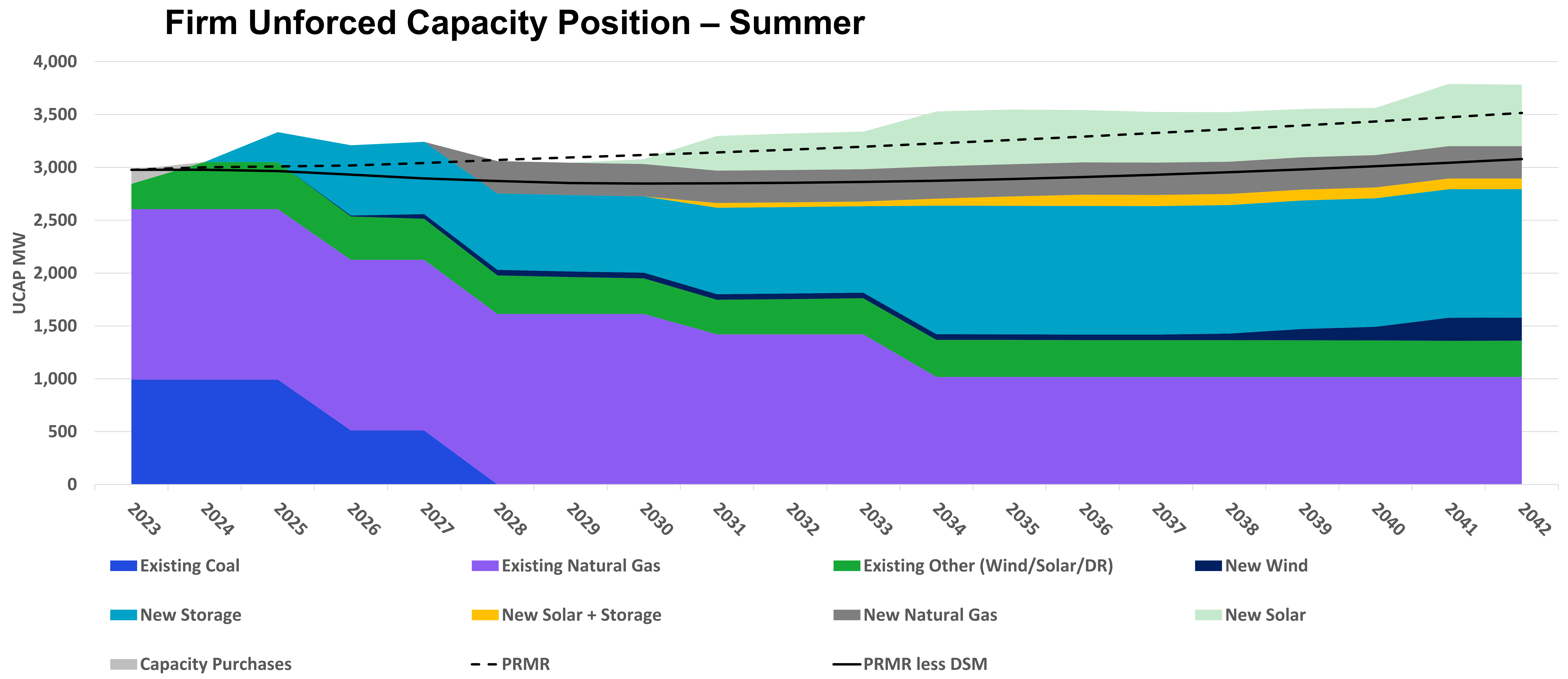
# D. Both Pete Units Retire (2026 & 2028)

| Scenarios | | | |
|---|---|---|---|
| No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| | $9,618 | | |


AES Indiana

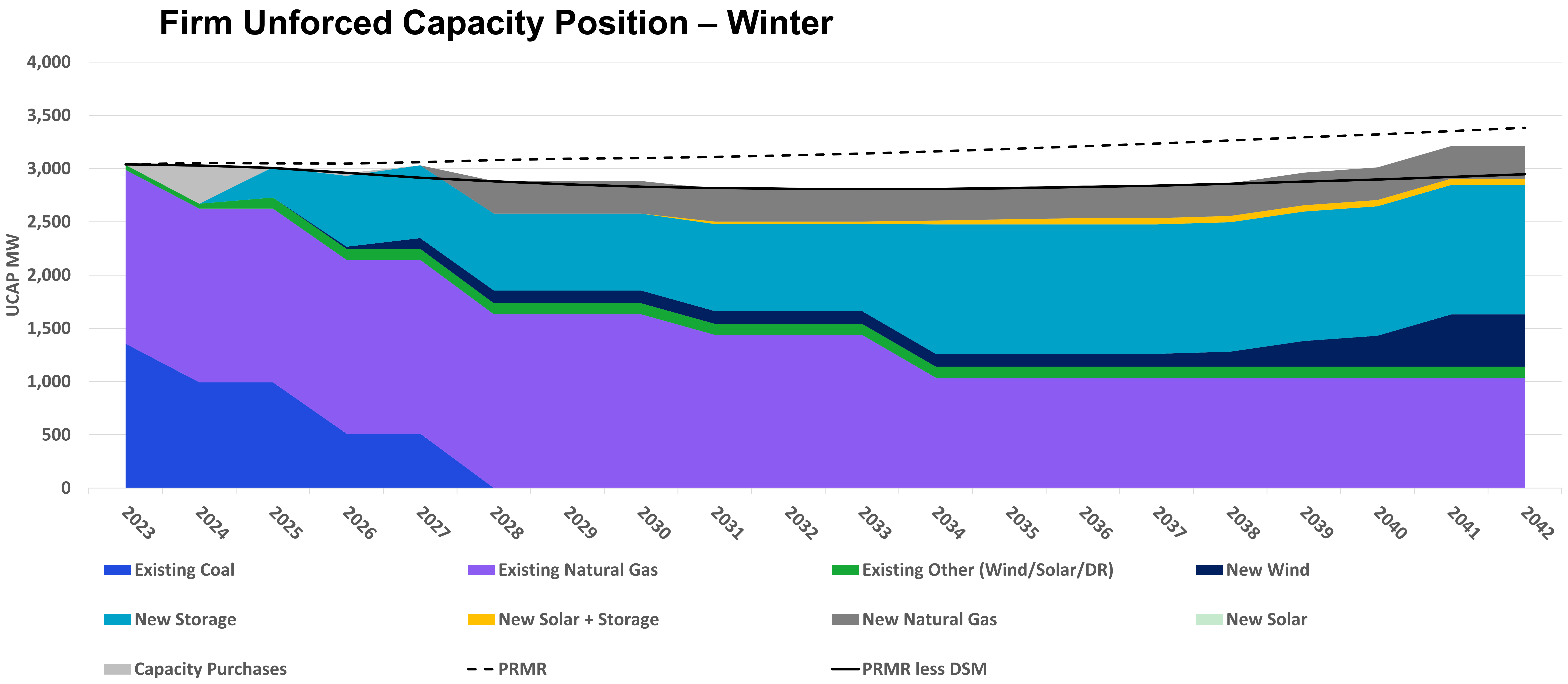
# Both Pete Units Retire: Current Trends *(Reference Case)*

***2026 & 2028***



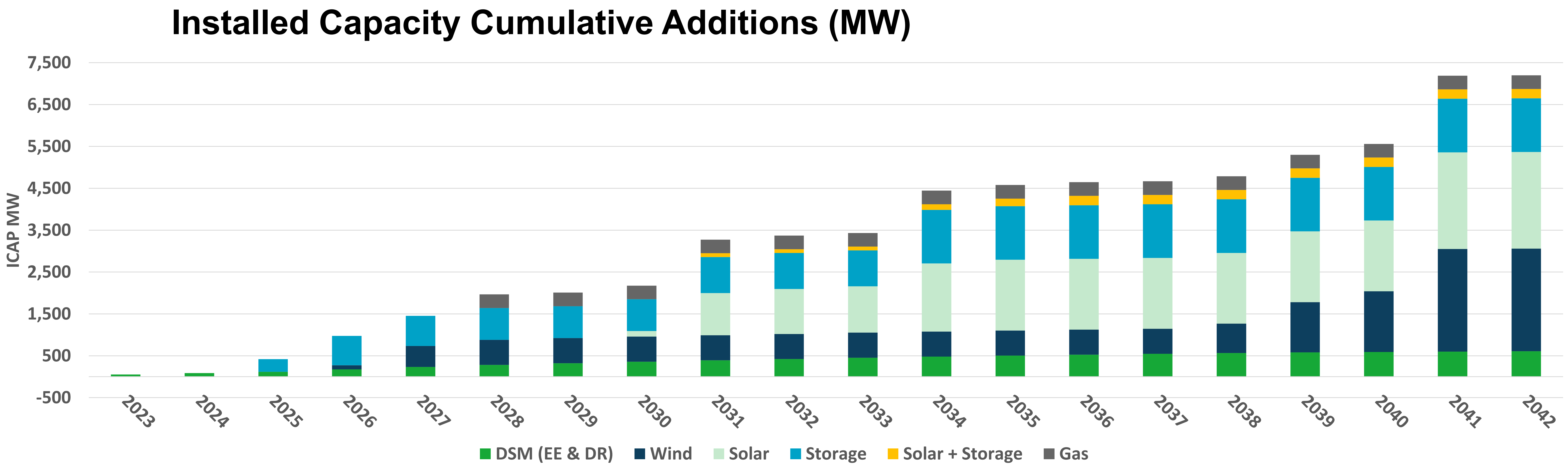
# Both Pete Units Retire: Current Trends *(Reference Case)*

***2026 & 2028***



# Both Pete Units Retire: Current Trends *(Reference Case)*

***2026 & 2028***

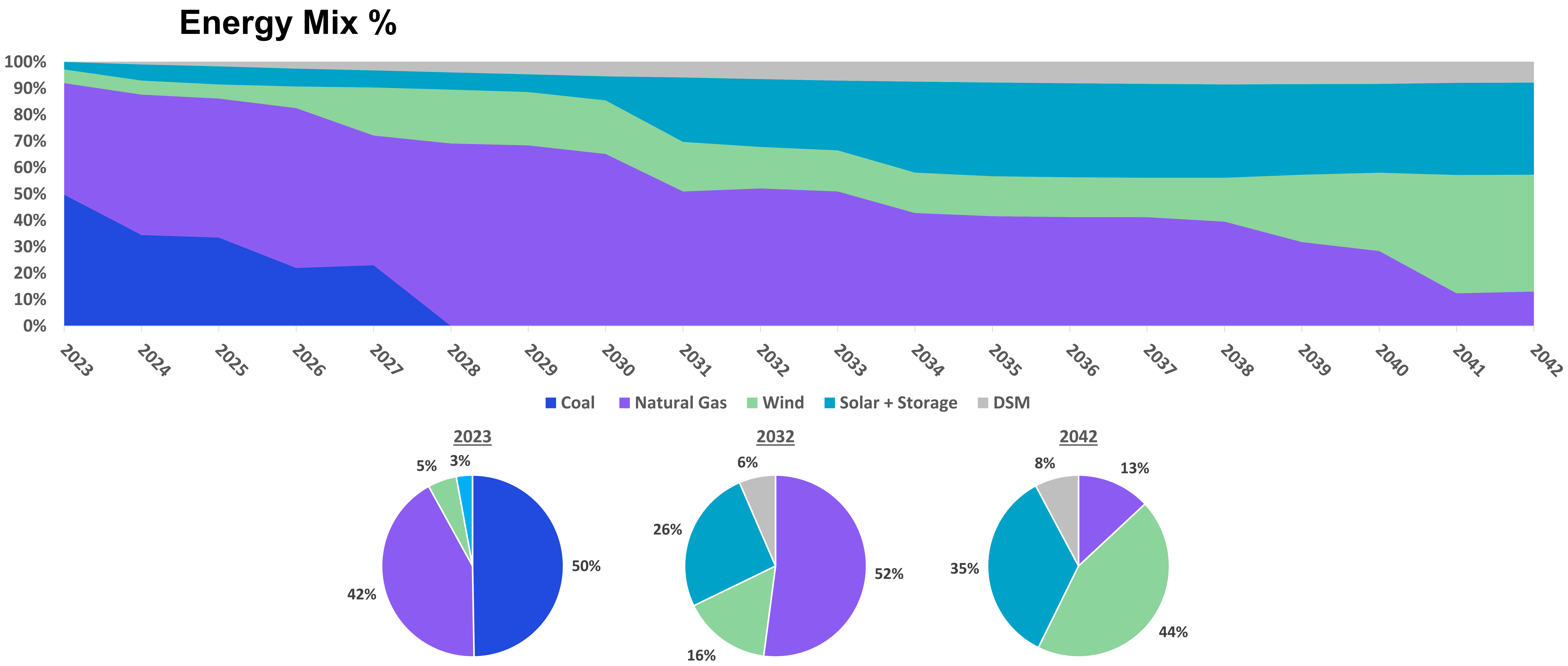



***Installed Capacity Incremental Additions (MW): 2023 – 2028***

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 100 | 400 | 100 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 300 | 400 | 20 | 40 |
| Solar + Storage | 0 | 0 | 0 | 0 | 0 | 0 |
| Natural Gas | 0 | 0 | 0 | 0 | 0 | 325 |

# Both Pete Units Retire: Current Trends *(Reference Case)*

***2026 & 2028***




| | |
|---|---|
| Thermal MWh % | 92% |
| Renewable/DSM MWh % | 8% |

| | |
|---|---|
| Thermal MWh % | 52% |
| Renewable/DSM MWh % | 48% |

| | |
|---|---|
| Thermal MWh % | 13% |
| Renewable/DSM MWh % | 87% |

# Both Pete Units Retire: Current Trends *(Reference Case)*

***2026 & 2028***

## DSM Results

### *Energy Efficiency:*

| | Vintage 1 | Vintage 2 | Vintage 3 |
|---|---|---|---|
| | 2024 - 2026 | 2027 - 2029 | 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 | 141,526 | 146,428 |
| | % of 2021 Sales ex. Opt-Out | % of 2021 Sales ex. Opt-Out | % of 2021 Sales ex. Opt-Out |
| | 1.0% | 1.1% | 1.2% |
| | Cummulative Summer MW | Cummulative Summer MW | Cummulative Summer MW |
| | 87 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 |
| | 195 MW |

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



aes Indiana

# Both Pete Units Retire: Current Trends *(Reference Case)*

***2026 & 2028***

## Portfolio Overview

### *Retirements*

Petersburg:

- Pete 3 Coal: 2026
- Pete 4 Coal: 2028
  - **Total Coal Retired MW: 1,040 MW**

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 610 MW
- Wind: 2,450 MW
- Solar: 2,308 MW
- Storage: 1,280 MW
- Solar + Storage: 225 MW
- Thermal: 325 MW

**Current Trends PVRR Summary**

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

| Strategy | PVRR |
|---|---|
| No Early Retirement | $9,572 |
| Pete Refuel to 100% Gas (est. 2025) | $9,330 |
| One Pete Unit Retires (2026) | $9,773 |
| Both Pete Units Retire (2026 & 2028) | $9,618 |
| "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | $9,711 |
| Encompass Optimization without predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027 | $9,262 |



aes Indiana

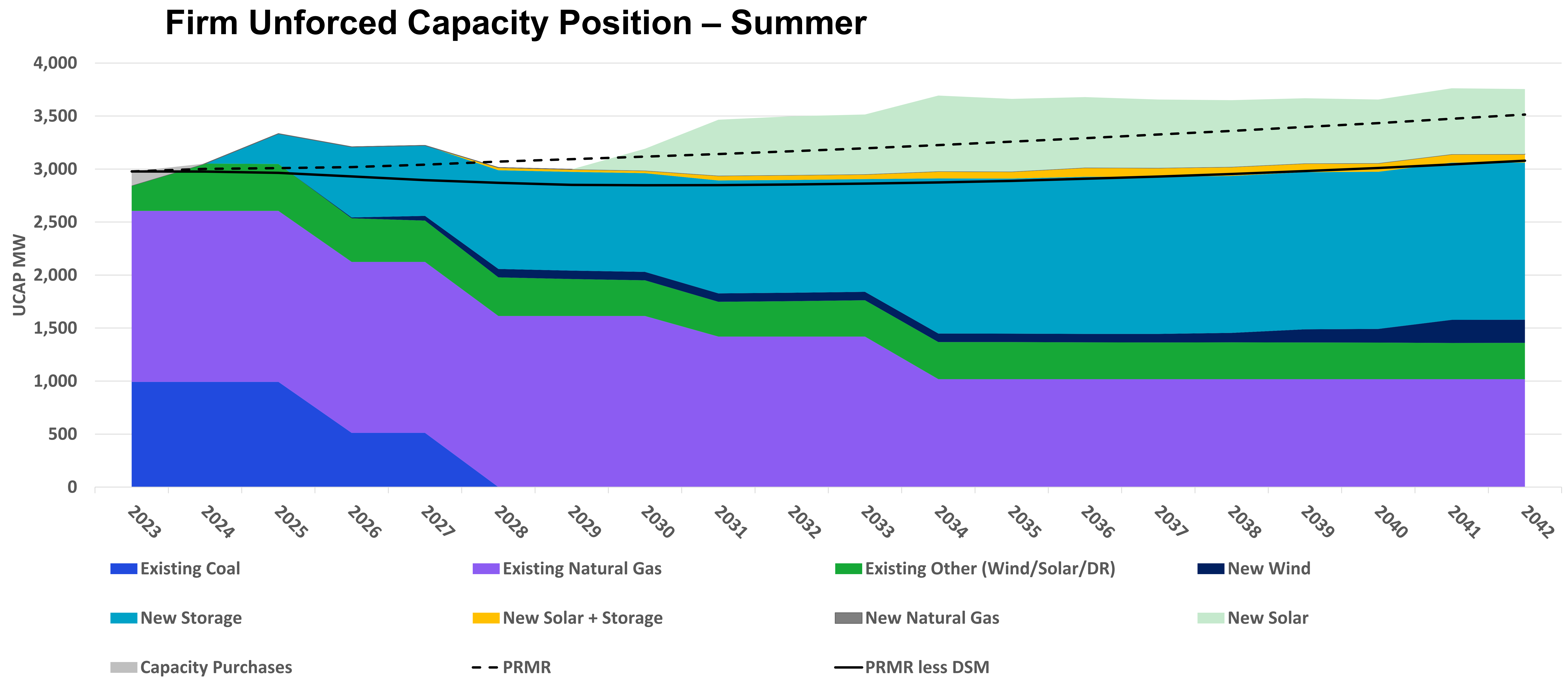
# E. Clean Energy Strategy

*Retire & Replace Pete with Clean Energy*

| Scenarios | | | |
|---|---|---|---|
| **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| | **$9,711** | | |

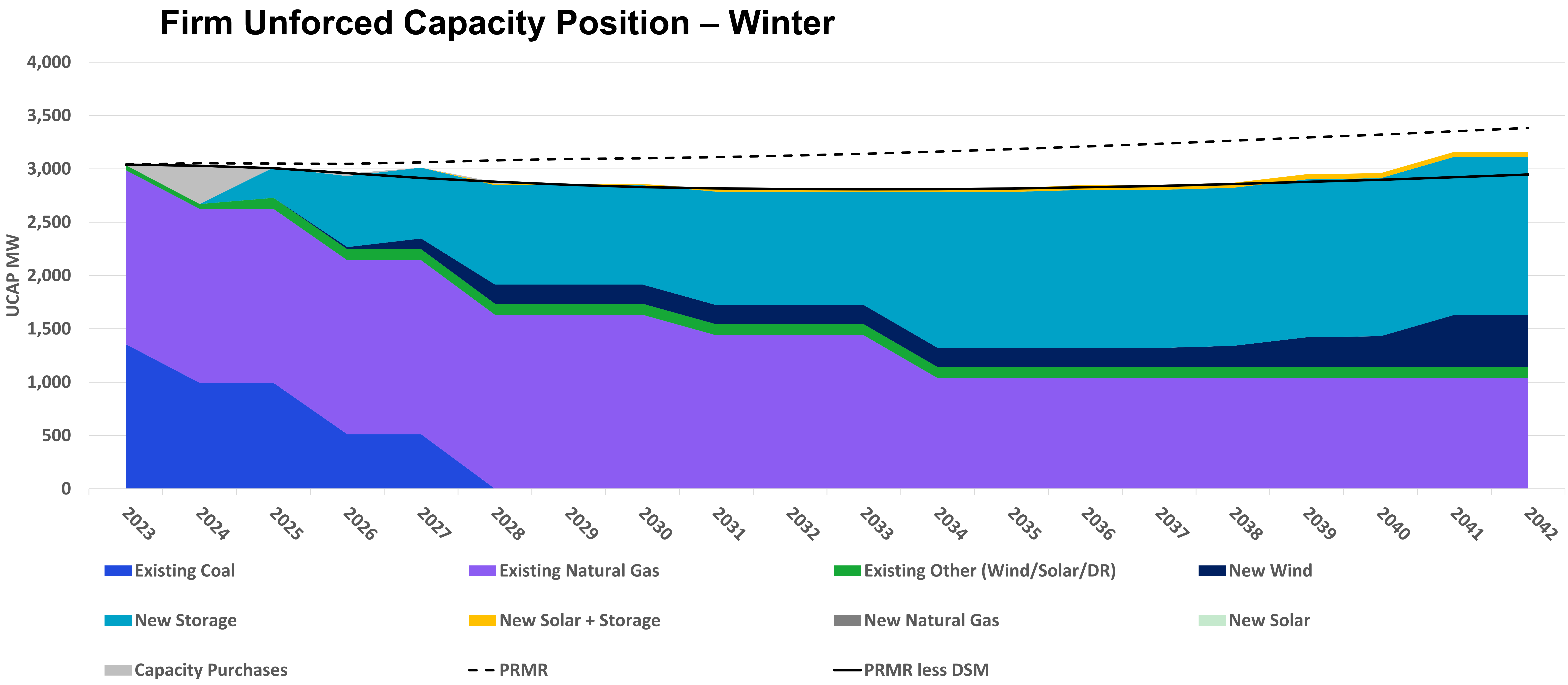
# Clean Energy Strategy: Current Trends *(Reference Case)*

***Retire & Replace Pete with Clean Energy***



# Clean Energy Strategy: Current Trends *(Reference Case)*

***Retire & Replace Pete with Clean Energy***



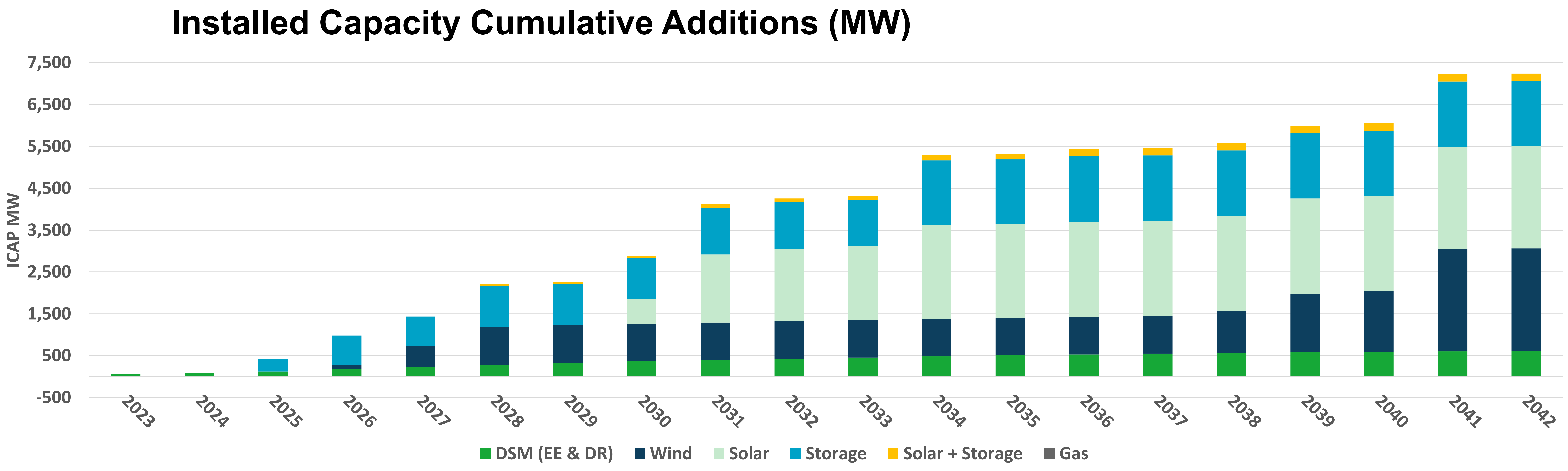





AES Indiana

# Clean Energy Strategy: Current Trends *(Reference Case)*

***Retire & Replace Pete with Clean Energy***



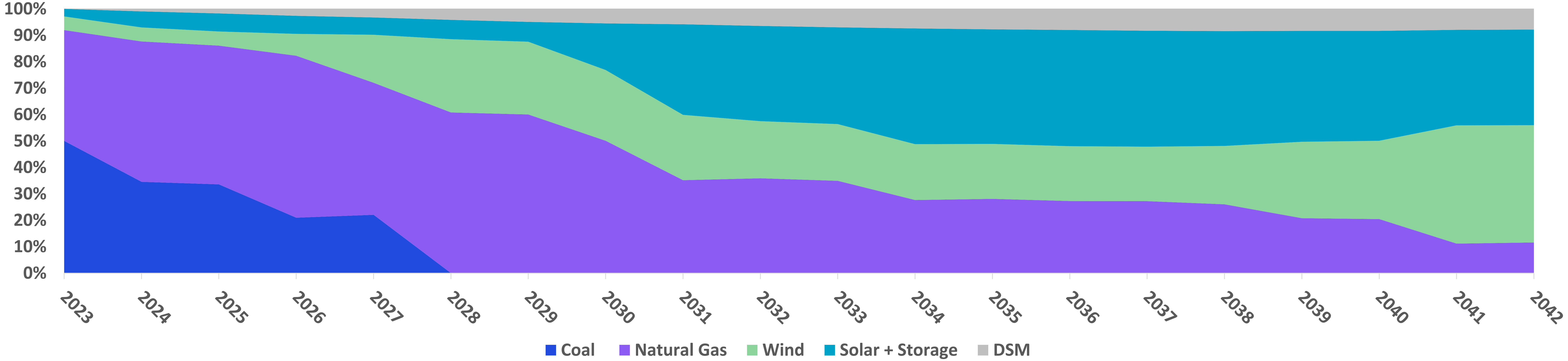

***Installed Capacity Incremental Additions (MW): 2023 – 2028***

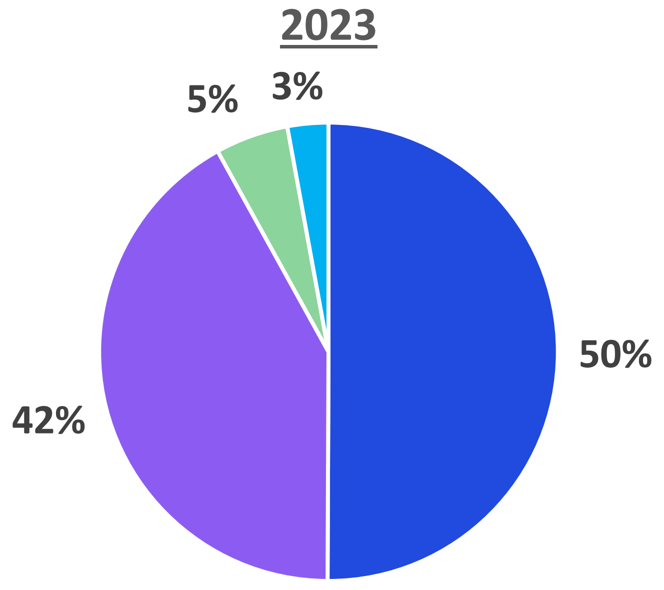
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 100 | 400 | 400 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 300 | 400 | 0 | 280 |
| Solar + Storage | 0 | 0 | 0 | 0 | 0 | 45 |
| Natural Gas | 0 | 0 | 0 | 0 | 0 | 0 |

# Clean Energy Strategy: Current Trends *(Reference Case)*

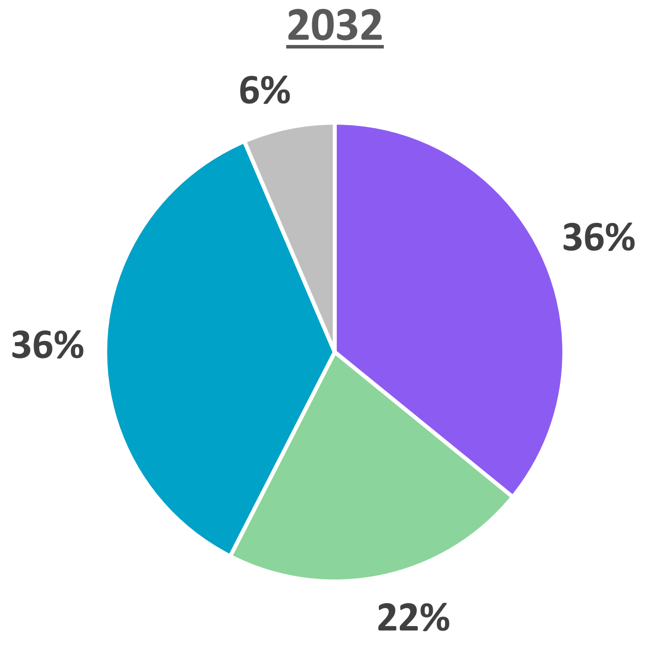
***Retire & Replace Pete with Clean Energy***

## Energy Mix %

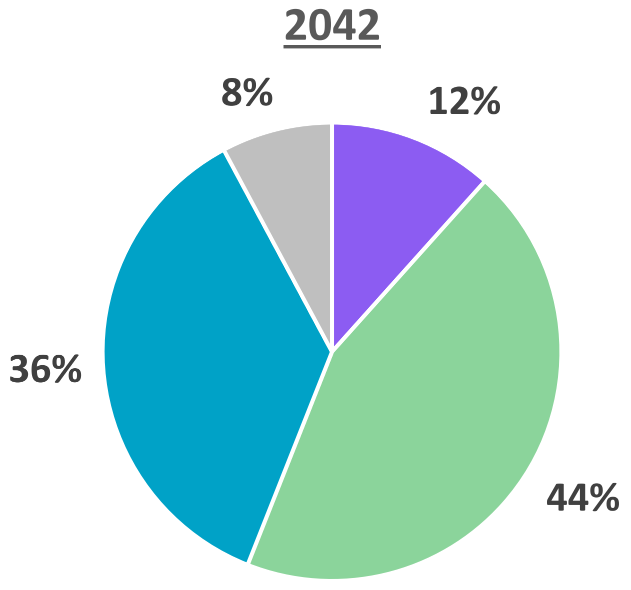



| | |
|---|---|
| Thermal MWh % | 92% |
| Renewable/DSM MWh % | 8% |




| | |
|---|---|
| Thermal MWh % | 36% |
| Renewable/DSM MWh % | 64% |




| | |
|---|---|
| Thermal MWh % | 12% |
| Renewable/DSM MWh % | 88% |



aes Indiana

# Clean Energy Strategy: Current Trends *(Reference Case)*

***Retire & Replace Pete with Clean Energy***

## DSM Results

### *Energy Efficiency:*

| | Vintage 1 | Vintage 2 | Vintage 3 |
|---|---|---|---|
| | **2024 - 2026** | **2027 - 2029** | **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 |
| | 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% | 1.2% |
| | Cummulative Summer MW | Cummulative Summer MW | Cummulative Summer MW |
| | 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 |
| | 195 MW |

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



aes Indiana

# Clean Energy Strategy: Current Trends *(Reference Case)*

***Retire & Replace Pete with Clean Energy***

## Portfolio Overview

### *Retirements*

Petersburg:

- Pete 3 Coal: 2026
- Pete 4 Coal: 2028
  - **Total Coal Retired MW: 1,040 MW**

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Retired Nat Gas MW: 618 MW**

### *Replacements by 2042*

- DSM: 610 MW
- Wind: 2,450 MW
- Solar: 2,438 MW
- Storage: 1,560 MW
- Solar + Storage: 180 MW
- Thermal: 0 MW

**Current Trends PVRR Summary**

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

| Strategy | PVRR |
|---|---|
| **No Early Retirement** | $9,572 |
| **Pete Refuel to 100% Gas (est. 2025)** | $9,330 |
| **One Pete Unit Retires (2026)** | $9,773 |
| **Both Pete Units Retire (2026 & 2028)** | $9,618 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,711 |
| **Encompass Optimization without predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027** | $9,262 |



aes Indiana

# F. Encompass Optimization

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

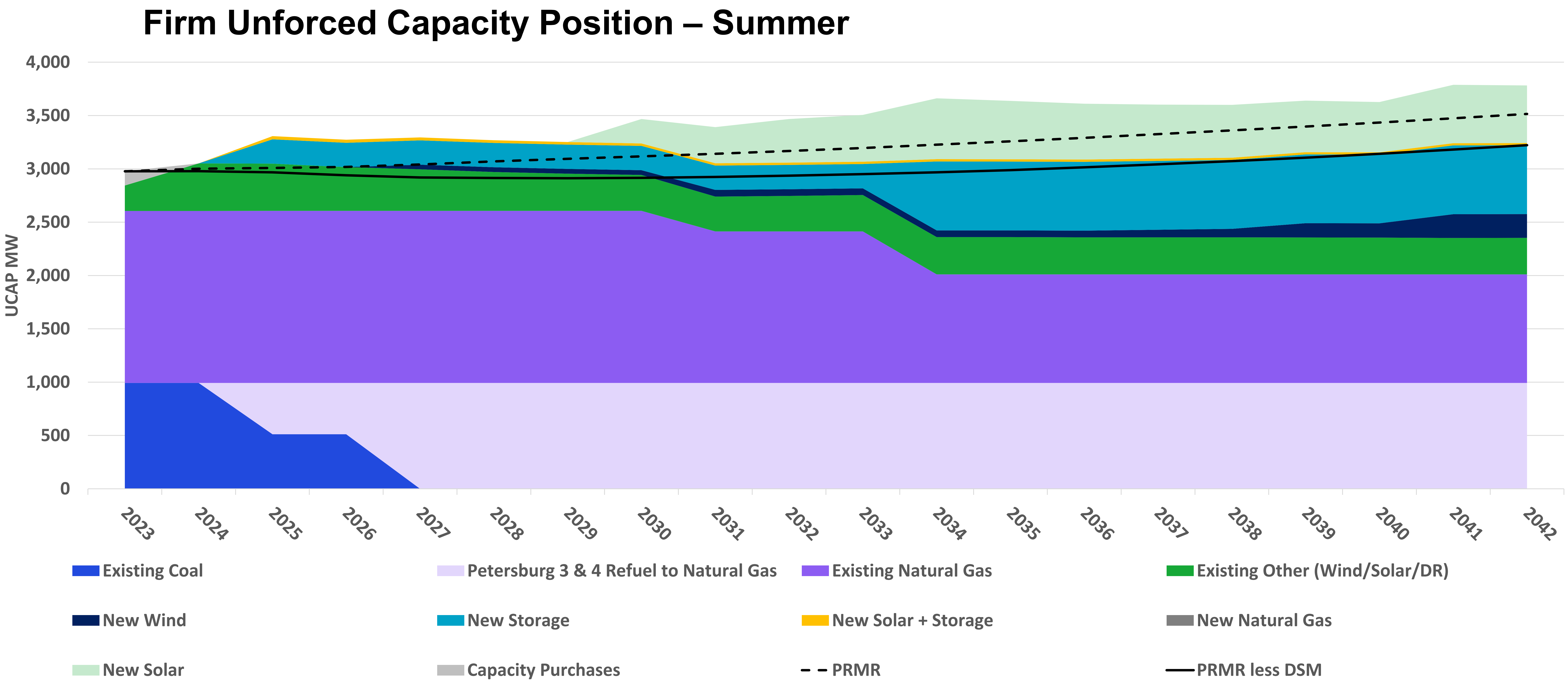
| Scenarios | | | |
|---|---|---|---|
| No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| | $9,262 | | |



aes Indiana

# Encompass Optimization: Current Trends *(Reference Case)*

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

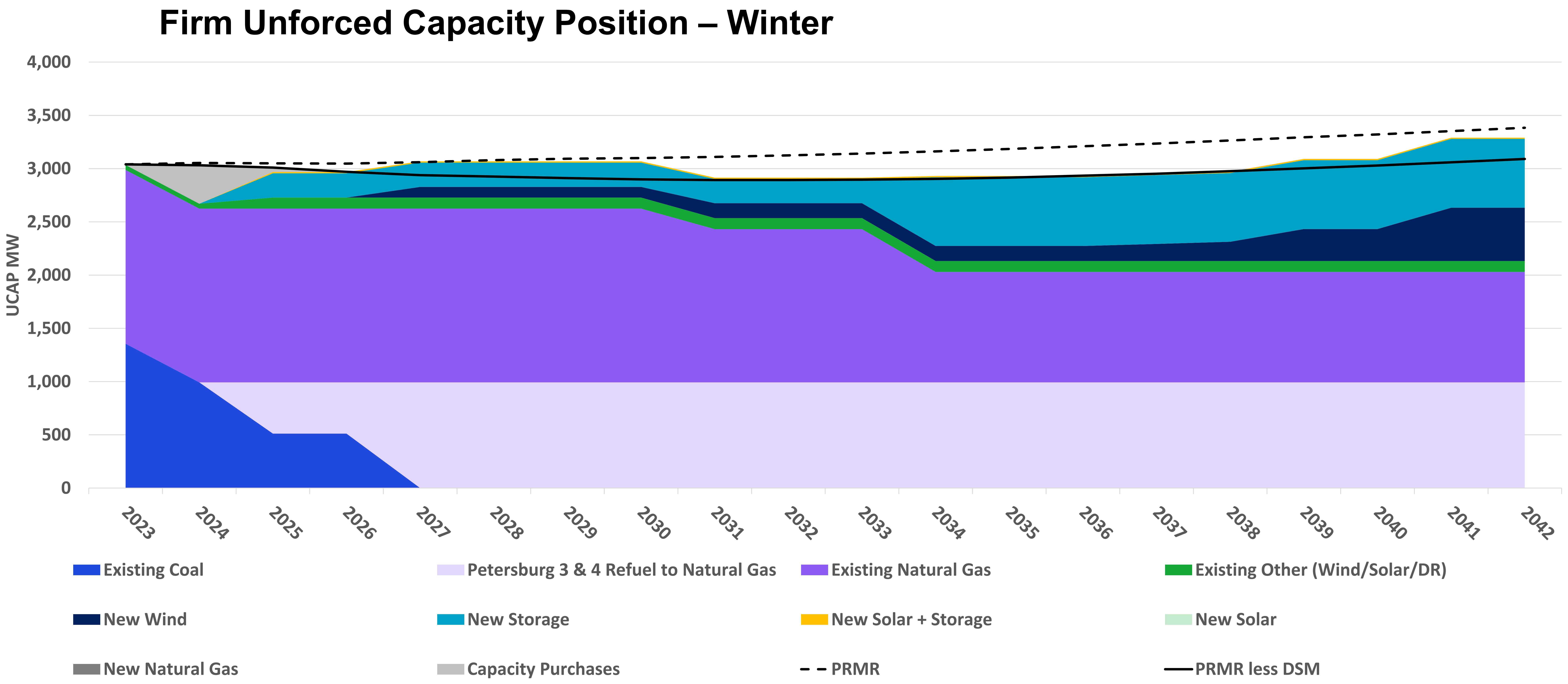




AES Indiana

# Encompass Optimization: Current Trends *(Reference Case)*

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

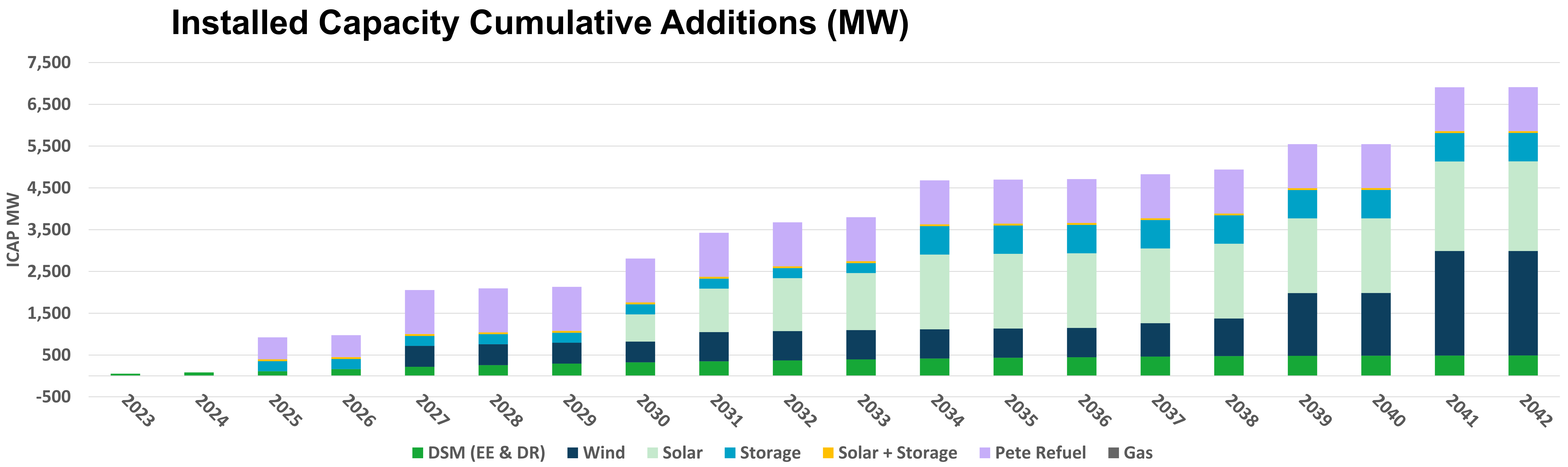





AES Indiana

# Encompass Optimization: Current Trends *(Reference Case)*

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




***Installed Capacity Incremental Additions (MW): 2023 - 2028***

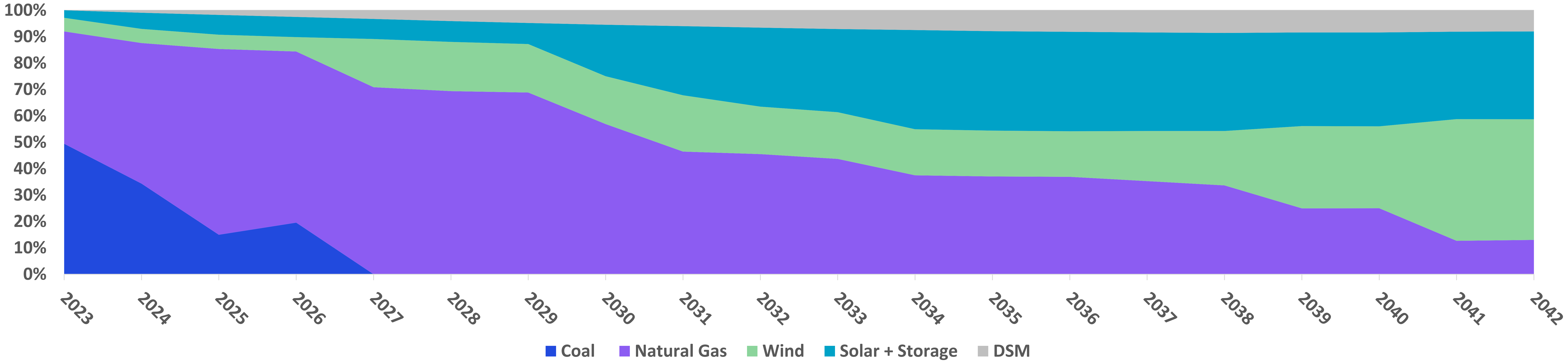
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Pete Refuel | 0 | 0 | 526 | 0 | 526 | 0 |
| Wind | 0 | 0 | 0 | 0 | 500 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 240 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |

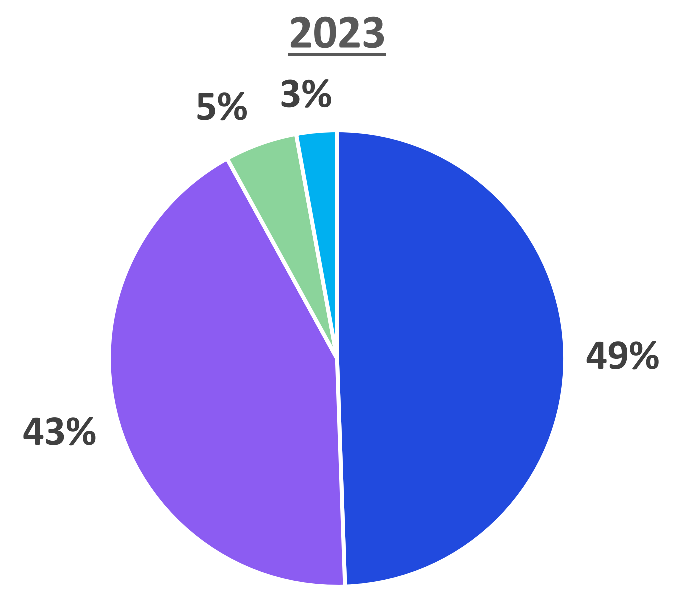

aes Indiana

# Encompass Optimization: Current Trends *(Reference Case)*

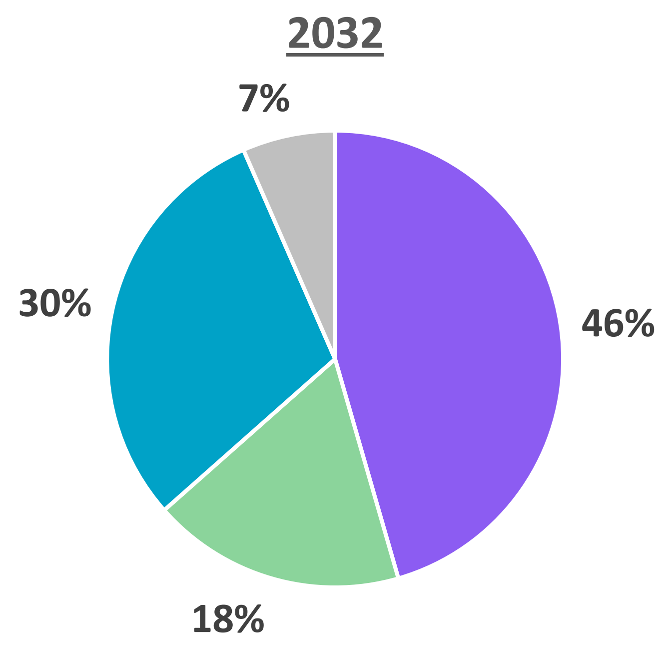
***Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027***

## Energy Mix %

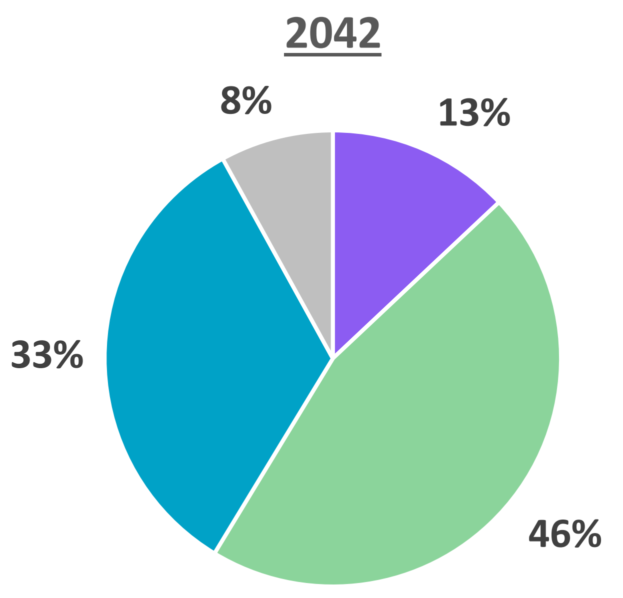



| | |
|---|---|
| Thermal MWh % | 92% |
| Renewable/DSM MWh % | 8% |




| | |
|---|---|
| Thermal MWh % | 46% |
| Renewable/DSM MWh % | 54% |




| | |
|---|---|
| Thermal MWh % | 13% |
| Renewable/DSM MWh % | 87% |



aes Indiana

# Encompass Optimization: Current Trends *(Reference Case)*

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

## DSM Results

### *Energy Efficiency:*

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

### *Demand Response:*

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

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



aes Indiana

# Encompass Optimization: Current Trends *(Reference Case)*

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

## Portfolio Overview

### *Retirements*

Petersburg:
- Pete 3 Coal: 2026
- Pete 4 Coal: 2028
  - **Total Refueled MW: 1,040 MW**

Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 490 MW
- Wind: 2,500 MW
- Solar: 2,145 MW
- Storage: 680 MW
- Solar + Storage: 45 MW
- Thermal: 0
- Pete 3 & 4 Refueled to Nat Gas: 1,052 MW

### Current Trends PVRR Summary

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

| Strategy | PVRR |
|---|---|
| **No Early Retirement** | $9,572 |
| **Pete Refuel to 100% Gas (est. 2025)** | $9,330 |
| **One Pete Unit Retires (2026)** | $9,773 |
| **Both Pete Units Retire (2026 & 2028)** | $9,618 |
| **Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,711 |
| **Encompass Optimization without predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027** | $9,262 |



aes Indiana

# Portfolio Matrix

| *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* | 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.

# Break for Lunch

| Time | Topic | Speakers |
|---|---|---|
| Afternoon<br>Starting at 12:30 PM | Replacement Resource Cost Sensitivity Analysis | Erik Miller, Manager, Resource Planning, AES Indiana |
| | Preliminary IRP Scorecard Results | Erik Miller, Manager, Resource Planning, AES Indiana |

# Replacement Resource Cost Sensitivity Analysis

**Erik Miller**, Manager, Resource Planning, AES Indiana

# Replacement Resource Cost Sensitivity Analysis Overview

As part of this IRP, AES Indiana conducted a sensitivity analysis on the capital costs for replacement resources. The analysis was conducted in response to the current volatility of replacement resource capital cost caused by supply constraints and potential solar tariffs.

## 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 replacement resource costs.

- → Low – low costs were based on the avg of the contemporary 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 RFP responses.
- → High – high costs were based on the upper half of the 2022 RFP responses.
- → Capacity Expansion (Retirement & Replacement) analysis was performed for each

Current Trends strategies at the three different replacement resource cost levels.

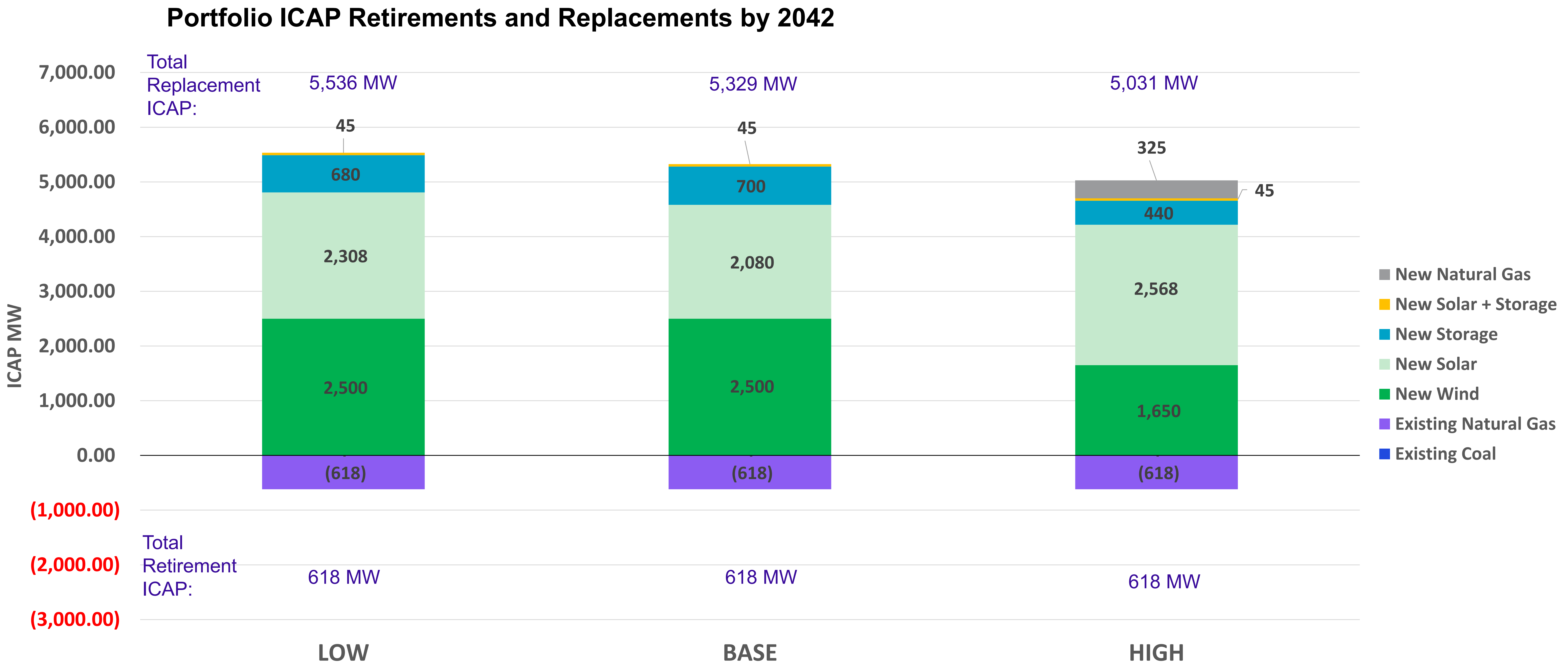
The following slides present the range of generation additions for each strategy that result from running capacity expansion with the different cost levels.

**Low, Base and High replacement resource costs (nominal $/kW unsubsidized) in 2025**

| | Low | Base | High |
|---|---|---|---|
| Wind | $1,477 | $1,909 | $2,340 |
| Solar | $1,036 | $1,364 | $1,925 |
| 4-hr Storage | $1,016 | $1,253 | $1,447 |
| 6-hr Storage | $1,525 | $1,880 | $2,170 |
| Hybrid | $985 | $1,270 | $1,689 |
| CCGT | $1,028 | $1,120 | $1,212 |
| Frame CT | $868 | $945 | $1,023 |
| Aero CT | $1,328 | $1,447 | $1,566 |
| Recip | $1,277 | $1,391 | $1,505 |

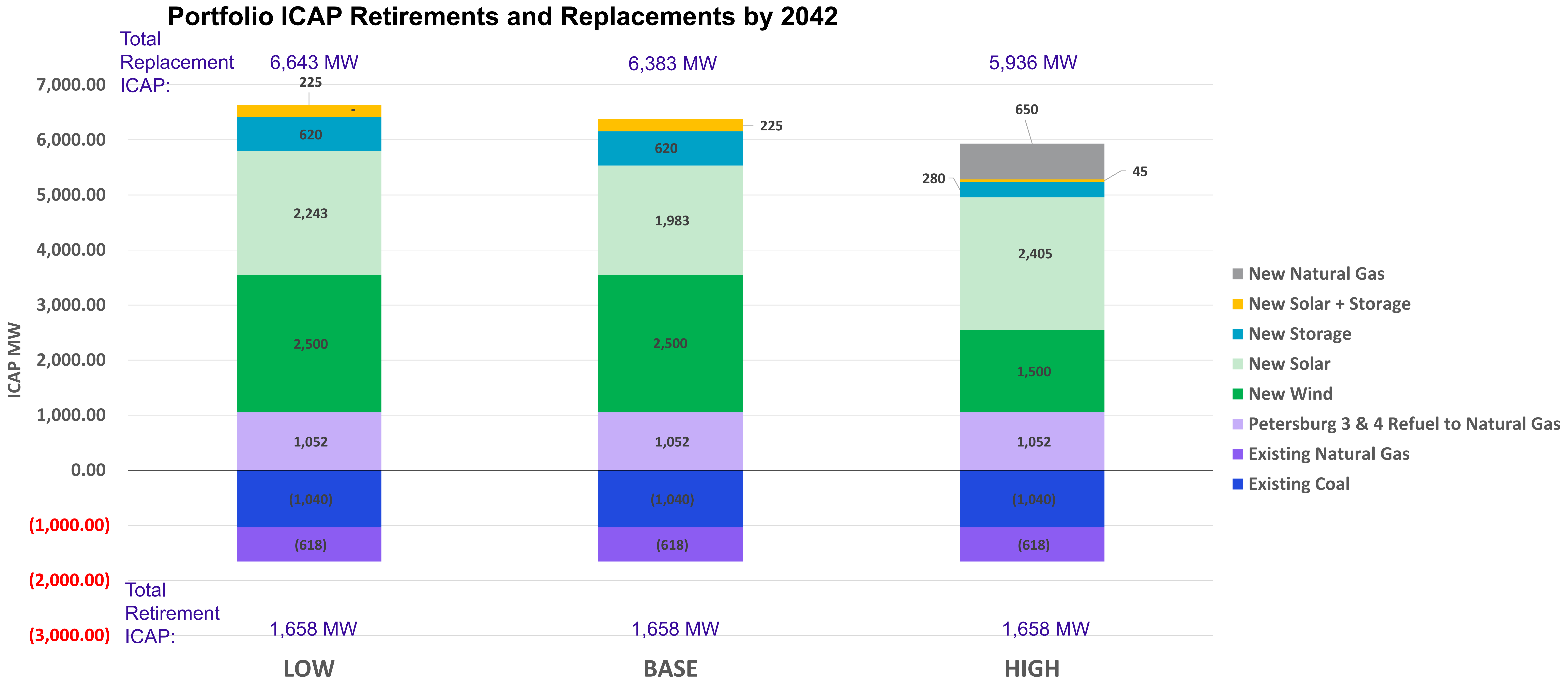
# Replacement Resource Cost Sensitivity

***No Early Retirement***



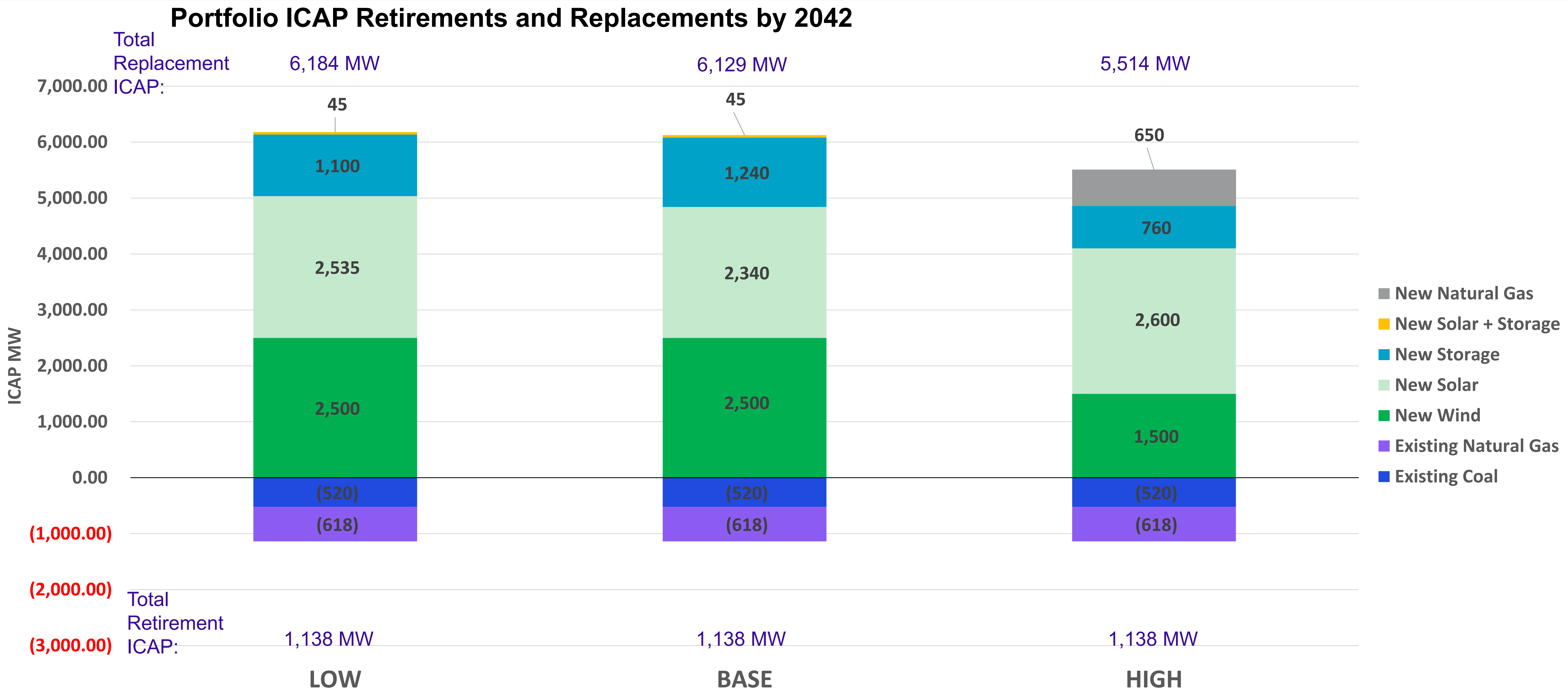
# Replacement Resource Cost Sensitivity

***Pete Refuel by 2025***



# Replacement Resource Cost Sensitivity

***One Pete Unit Retires***

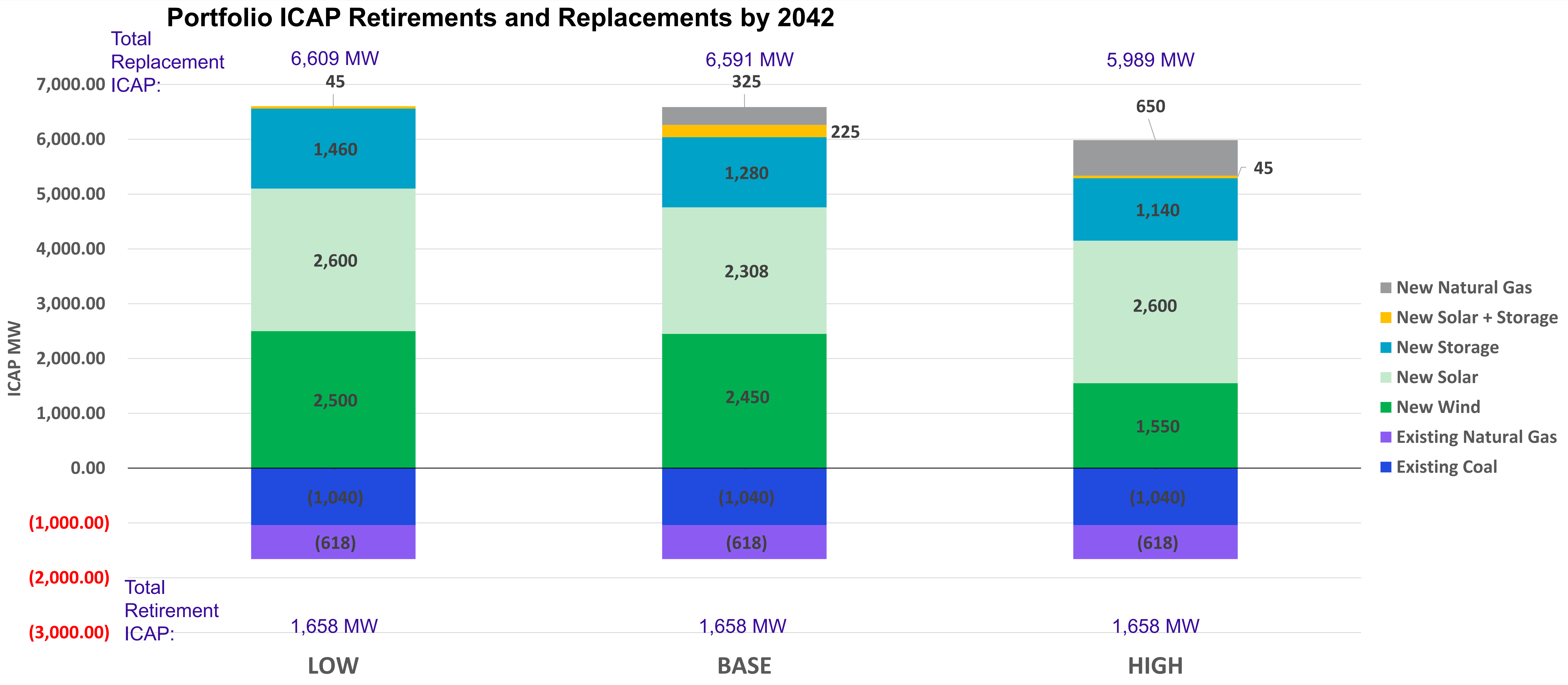





AES Indiana

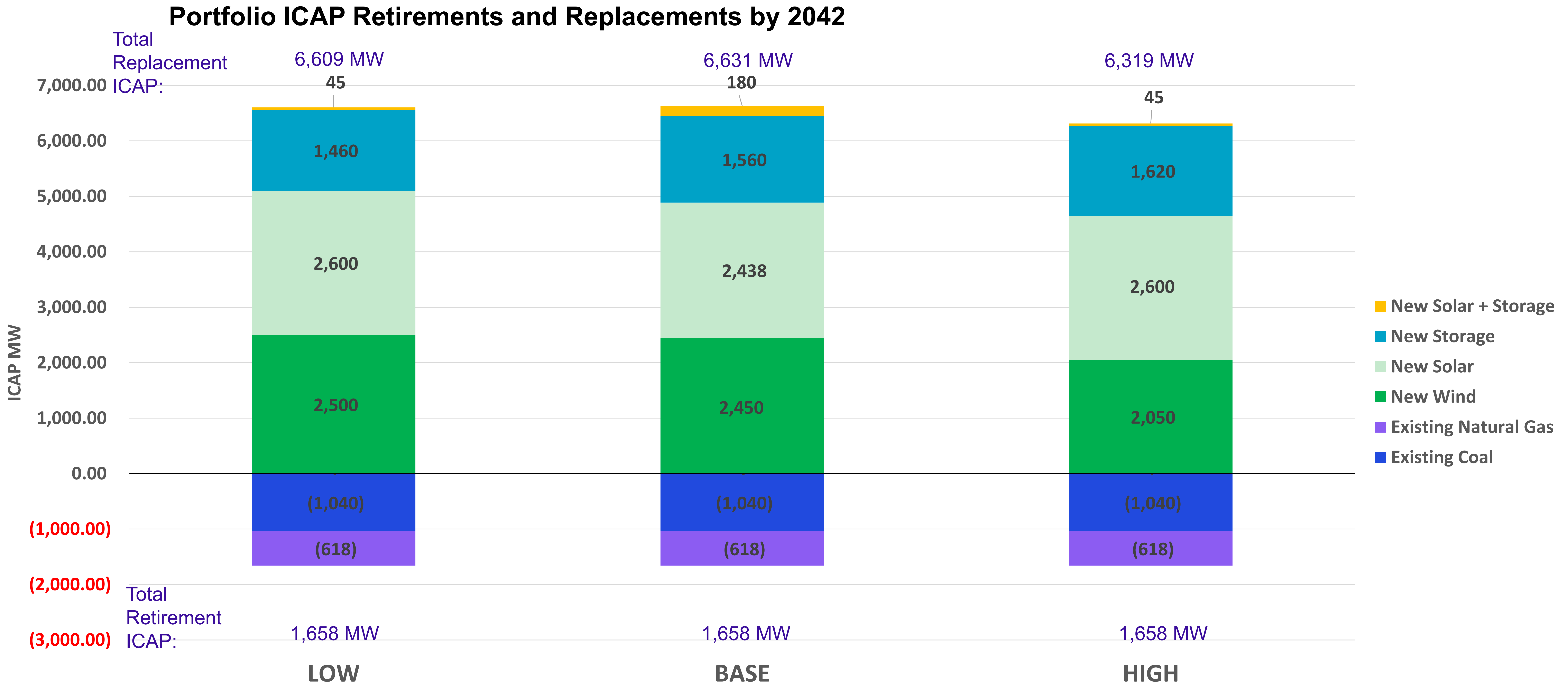
# Replacement Resource Cost Sensitivity

***Both Pete Unite Retire***



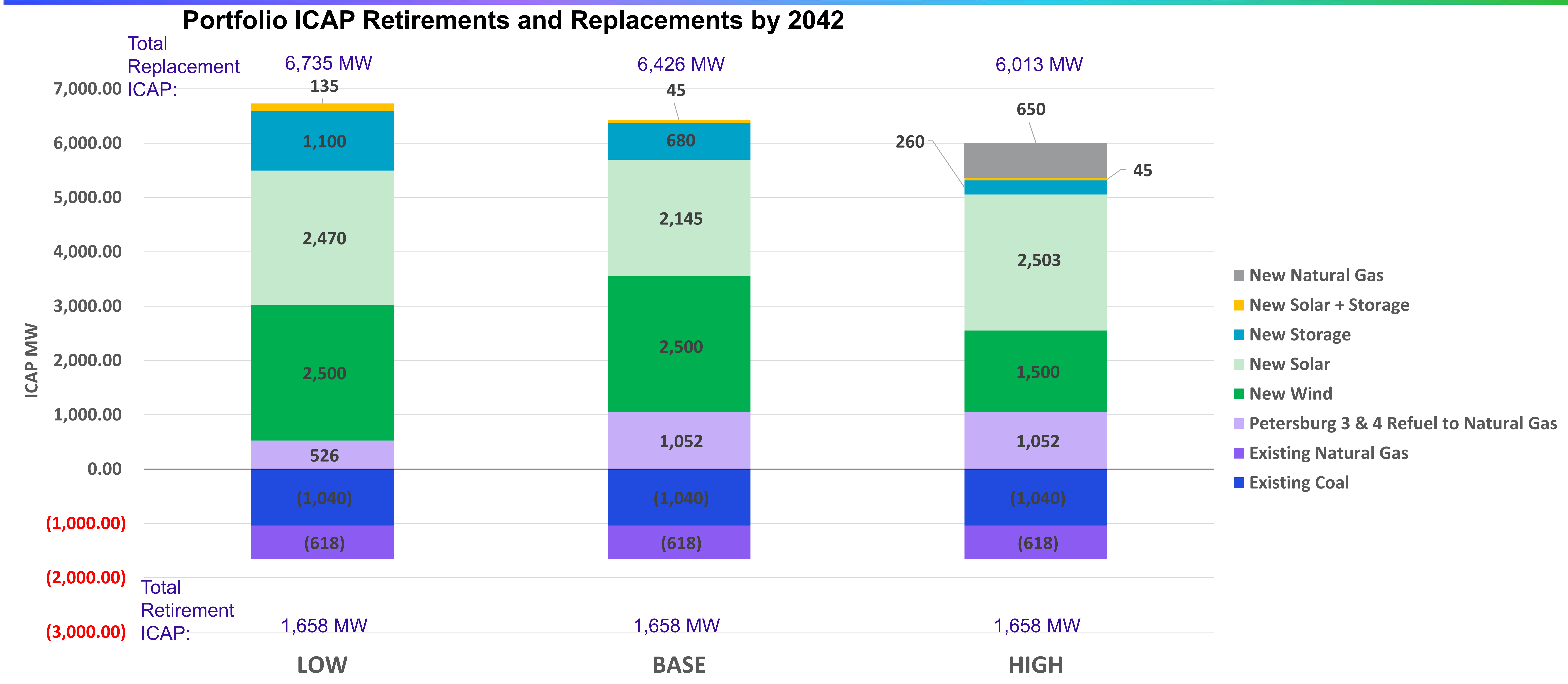
# Replacement Resource Cost Sensitivity

## *Clean Energy Strategy*



# Replacement Resource Cost Sensitivity

## *Encompass Optimization*






aes Indiana

# Replacement Resource Cost Sensitivity

## *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* | 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.

# Preliminary IRP Scorecard Results

**Erik Miller**, Manager, Resource Planning, AES Indiana

# Preliminary Scorecard Results

## Affordability, Environmental Sustainability and Risk & Opportunity metrics for the Current Trends portfolios

| | 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* | *Cost Opportunity* | *Cost Risk* | *Market Exposure* | *Renewable Capital Cost Risk (+50%)* | *Employees (+/-)* | *Property Taxes* |
| | Present Value of Revenue Requirements (2023 $000,000) | CO2 Emissions (mmtons) 2023 - 2032 | SO2 Emissions (tons) 2023 - 2032 | NOx Emissions (tons) 2023 - 2032 | Water Use (mmgal) 2023 - 2032 | CCP (tons) 2023 - 2032 | % Renewable Energy in 2032 | Composite score from Reliability Analysis | Lowest PVRR across policy scenarios | Highest PVRR across policy scenarios | Mean - P95 | P95 - Mean | 20-year avg sales + purchases | Portfolio PVRR w/ renewable costs +50% | Total FTEs associated with generation | Total amount of property tax paid from AES IN assets (2023 $000,000) |
| 1 | $ 9,572 | 73.2 | 49,944 | 34,755 | 28.4 | 5,126 | 45% | | | | | | | | | $ 173 |
| 2 | $ 9,330 | 54.5 | 13,402 | 19,501 | 7.9 | 1,417 | 55% | | | | | | | | | $ 211 |
| 3 | $ 9,773 | 65.2 | 37,102 | 33,243 | 26.7 | 4,813 | 52% | | | | | | | | | $ 215 |
| 4 | $ 9,618 | 58.6 | 25,506 | 23,102 | 15.0 | 2,700 | 48% | | | | | | | | | $ 248 |
| 5 | $ 9,711 | 55.3 | 25,254 | 23,303 | 14.8 | 2,676 | 64% | | | | | | | | | $ 262 |
| 6 | $ 9,262 | 56.6 | 18,503 | 22,559 | 10.9 | 1,970 | 54% | | | | | | | | | $ 203 |

Metrics Still in Progress

→ **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

Complete Scorecard review and selection of the Preferred Resource Portfolio will be topics for Public Advisory Meeting # 5.

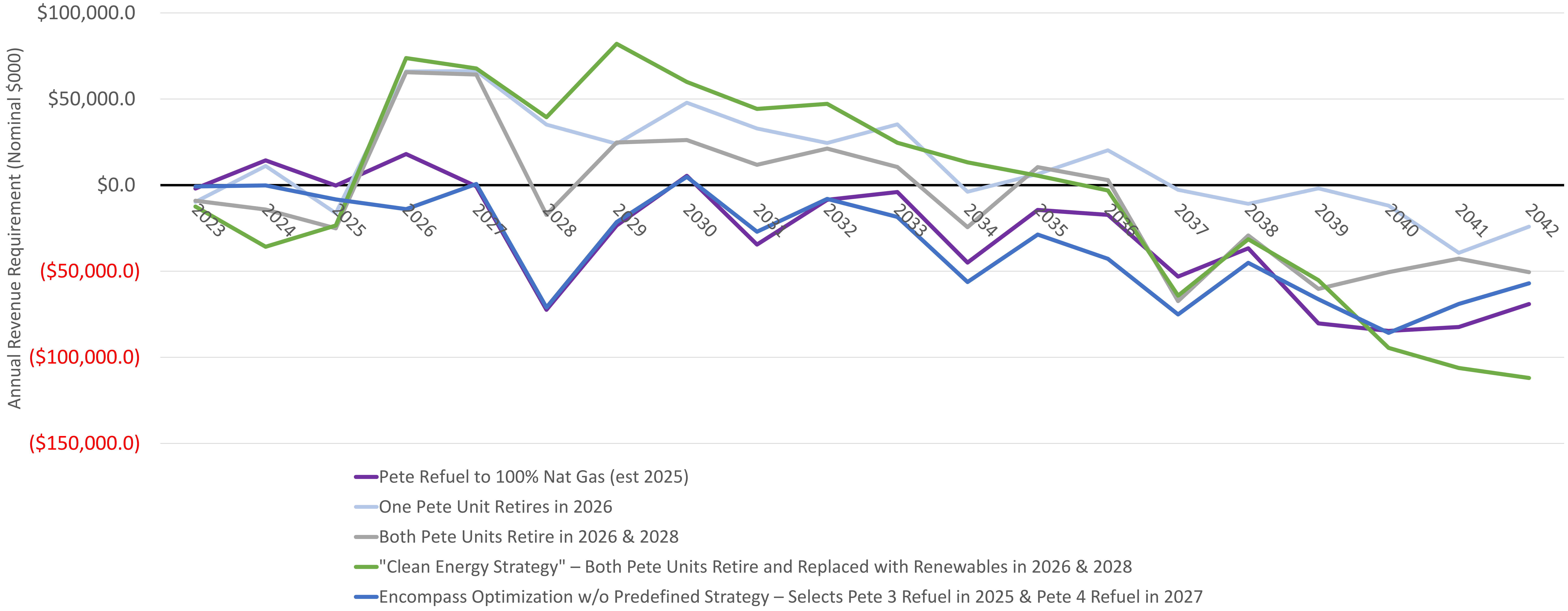


aes Indiana

# IRP Annual Revenue Requirement

## *Compared to the No Retirement ("Status Quo") Scenario*

**Presented revenue requirement is only for incremental generation capital expenditures**






aes Indiana

# Final Q&A and Next Steps

# Public Advisory Meeting

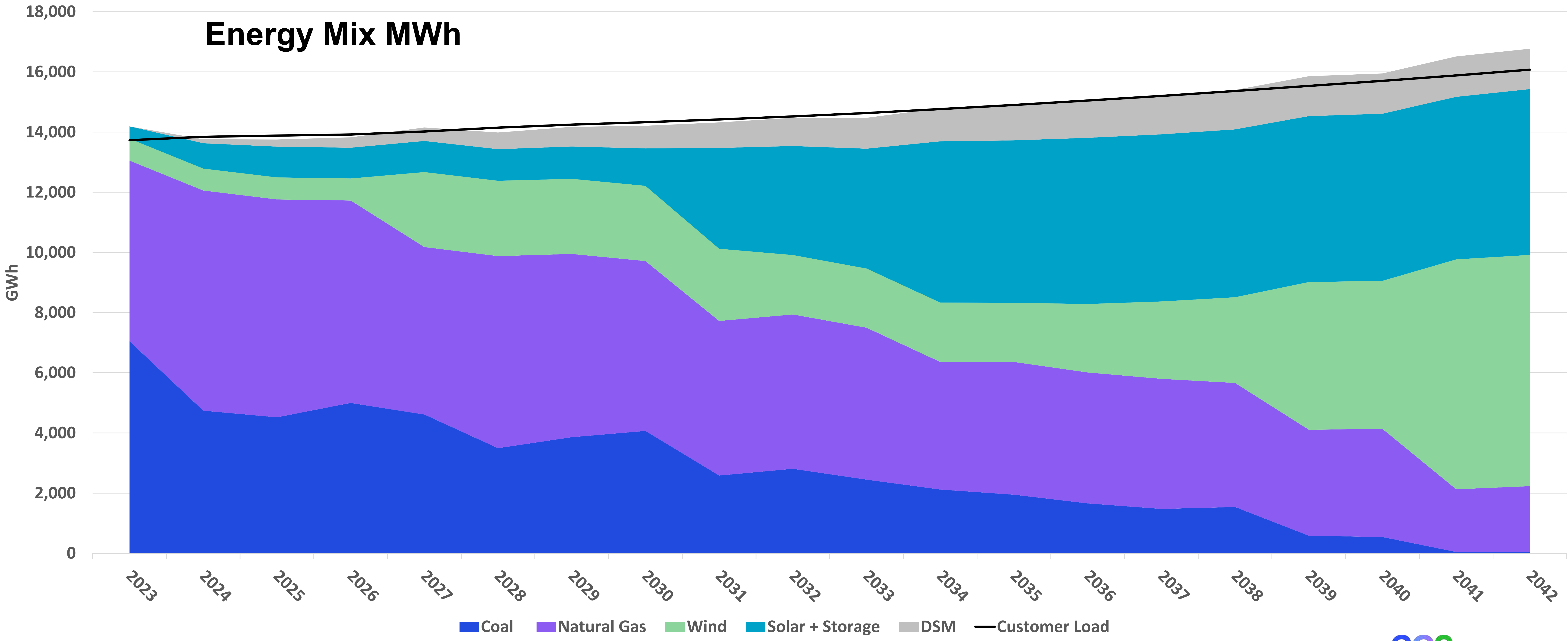
| Public Advisory Meeting #1 | Public Advisory Meeting #2 | Public Advisory Meeting #3 | Public Advisory Meeting #4 | Public Advisory Meeting #5 |
|---|---|---|---|---|
| **Jan. 24, 2022** | **April 12, 2022** | **June 27, 2022** | **Sept. 19, 2022** | **Oct./Nov. 2022** |

- All meetings will be available for attendance via Teams. Meetings in 2022 may also occur in-person.
- A Technical Meeting will be held the week preceding each Public Advisory Meeting for stakeholders with nondisclosure agreements. Tech Meeting topics will focus on those anticipated at the next Public Advisory Meeting.
- Meeting materials can be accessed at ***www.aesindiana.com/integrated-resource-plan.***

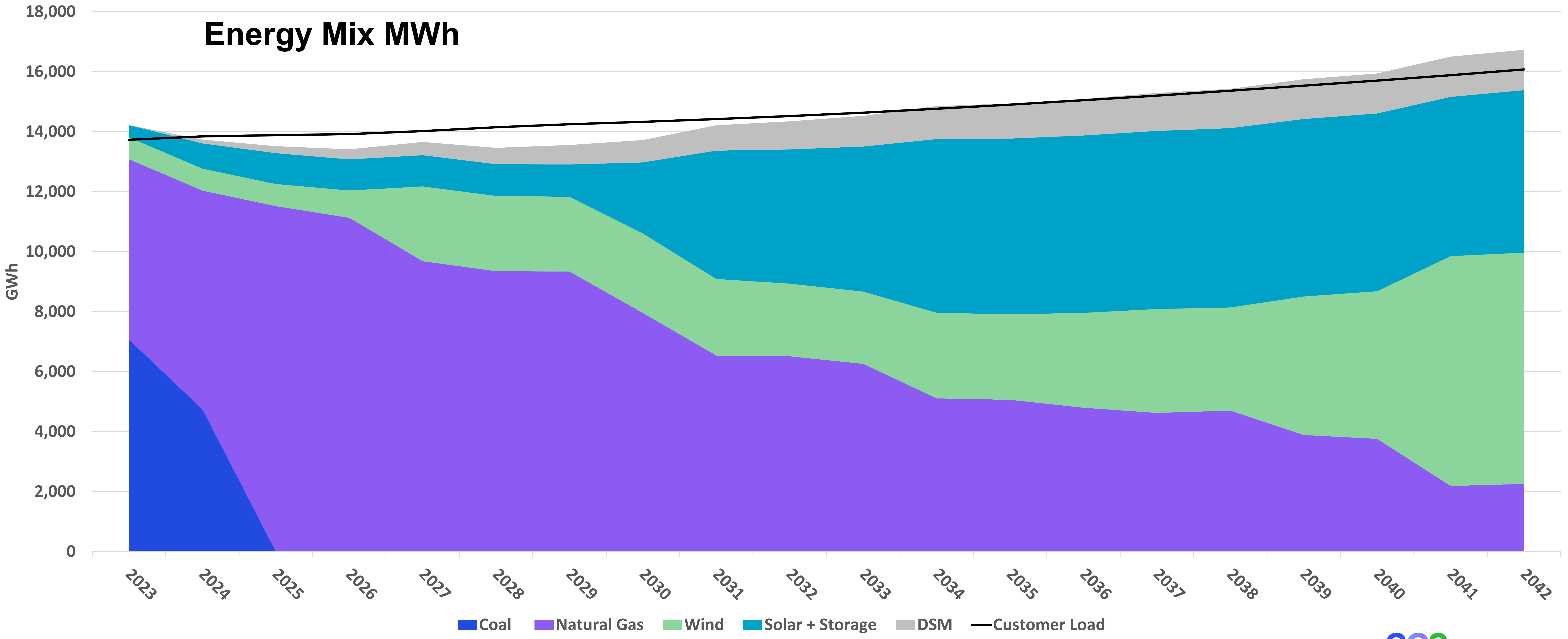
# Thank You

# Appendix

# No Early Retirement: Current Trends *(Reference Case)*



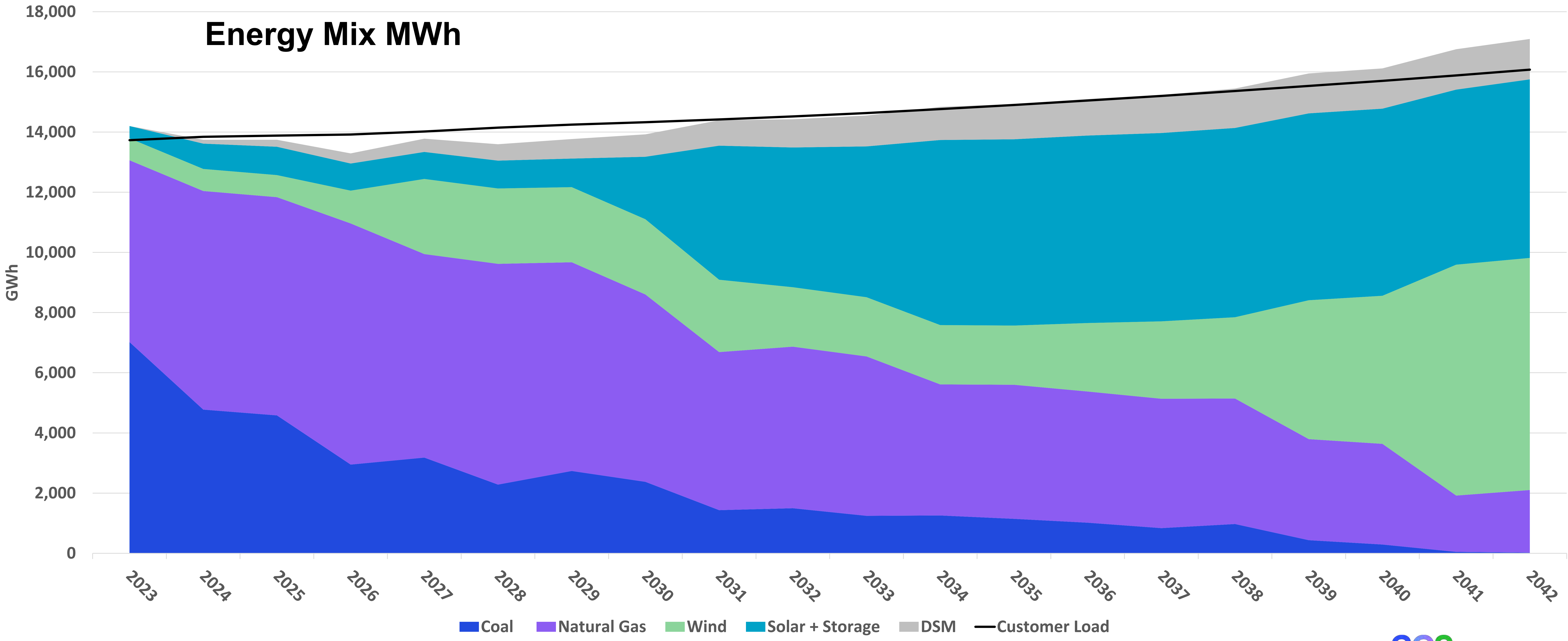
# Pete 3 & 4 Refuel in 2025: Current Trends *(Reference Case)*






AES Indiana

# One Pete Unit Retires (2026): Current Trends *(Reference Case)*

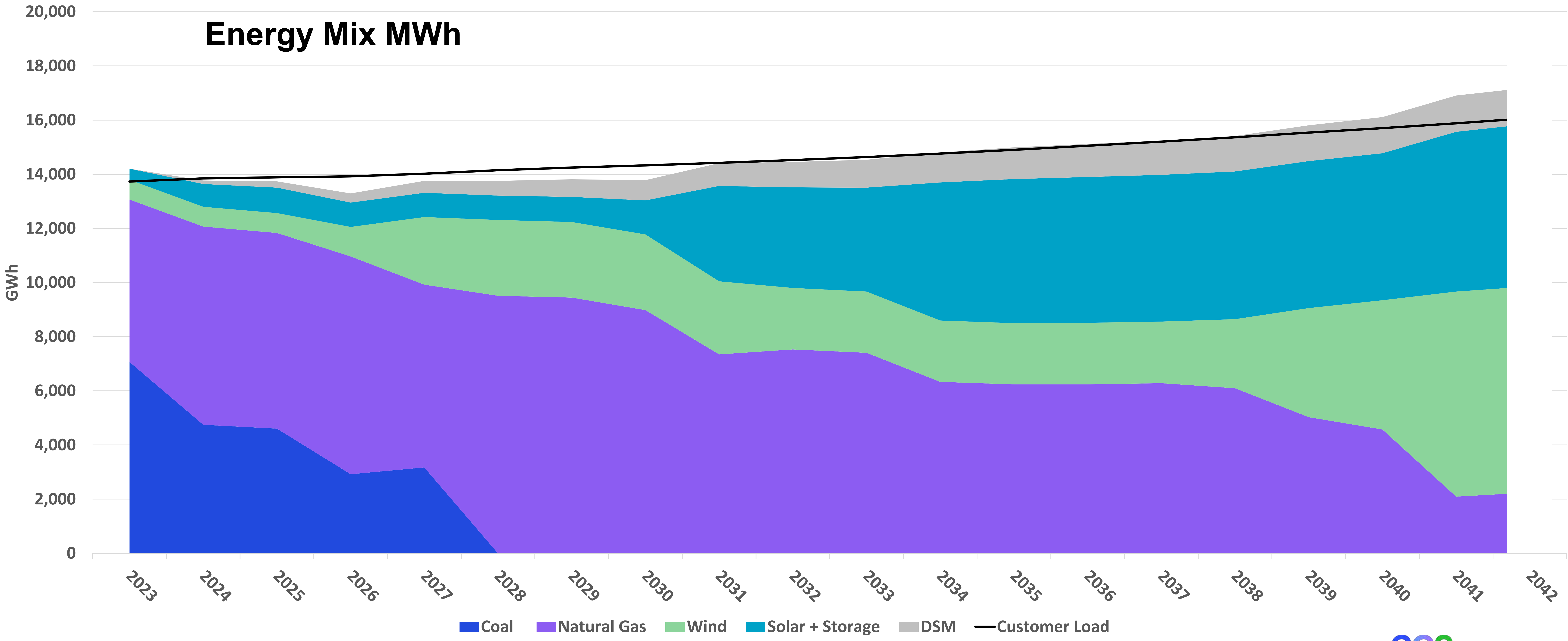




aes Indiana

# Both Pete Units Retire: Current Trends *(Reference Case)*

***2026 & 2028***

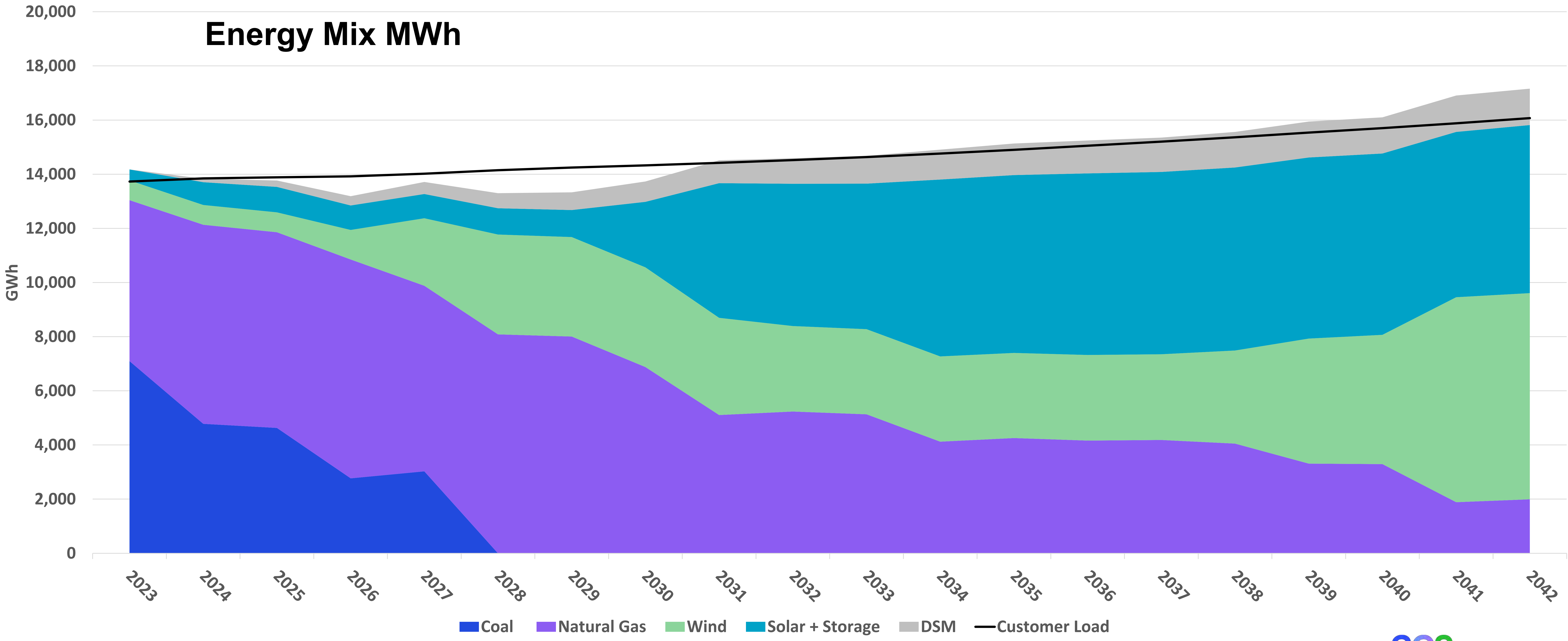





aes Indiana

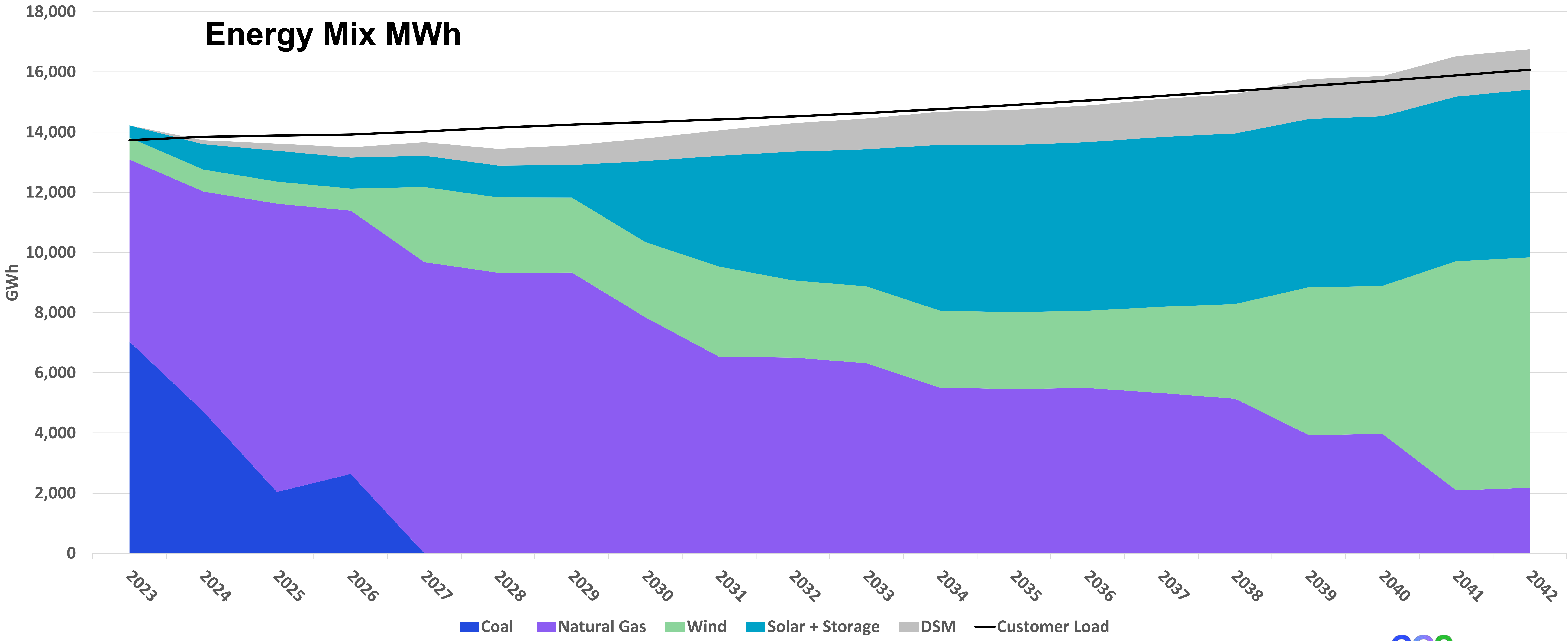
# Clean Energy Strategy: Current Trends *(Reference Case)*

***Retire & Replace Pete with Clean Energy***



# Encompass Optimization: Current Trends *(Reference Case)*

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





aes Indiana

# Environmental Sustainability Metrics

| Environmental Sustainability | | | | | |
|---|---|---|---|---|---|
| ***$CO_2$ Emissions*** | ***$SO_2$ Emissions*** | ***$NO_X$ Emissions*** | ***Water Use*** | ***Coal Combustion Products (CCP)*** | ***Clean Energy Progress*** |
| Total portfolio CO2 Emissions (mmtons) 2023 - 2042 | Total portfolio SO2 Emissions (tons) 2023 - 2042 | Total portfolio NOx Emissions (tons) 2023 - 2042 | Water Use (mmgal) 2023 - 2042 | CCP (tons) 2023 - 2042 | % Renewable Energy in 2032 |
| 101.9 | 64,991 | 45,605 | 36.7 | 6,611 | 45% |
| 72.5 | 13,513 | 22,146 | 7.9 | 1,417 | 55% |
| 88.1 | 45,544 | 42,042 | 26.7 | 4,813 | 52% |
| 79.5 | 25,649 | 24,932 | 15.0 | 2,700 | 48% |
| 69.8 | 25,383 | 24,881 | 14.8 | 2,676 | 64% |
| 76.1 | 18,622 | 25,645 | 10.9 | 1,970 | 54% |

## 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

# 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 Selective Catalytic Reduction System
- EV: Electric Vehicle
- FLOC: Federated Learning of Cohorts
- FTE: Full-Time Employee
- GDP: Gross Domestic Product
- GFL: Grid-Following 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
- IEEE: Institute of Electrical and Electronics Engineers



AES Indiana

# IRP Acronyms

- 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
- 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
- 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

# No Environmental Action

| | | Scenarios |
|---|---|---|
| | *20-Year PVRR (2023$MM, 2023-2042)* | **No Environmental Action** |
| **Generation Strategies** | **No Early Retirement** | **$7,111** |
| | **Pete Refuel to 100% Gas (est. 2025)** | **$6,621** |
| | **One Pete Unit Retires (2026)** | **$7,462** |
| | **Both Pete Units Retire (2026 & 2028)** | **$7,425** |
| | **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | **$9,211** |
| | **Encompass Optimization without predefined Strategy – Selects Pete 3 & 4 Refuel in 2025** | **$6,610** |



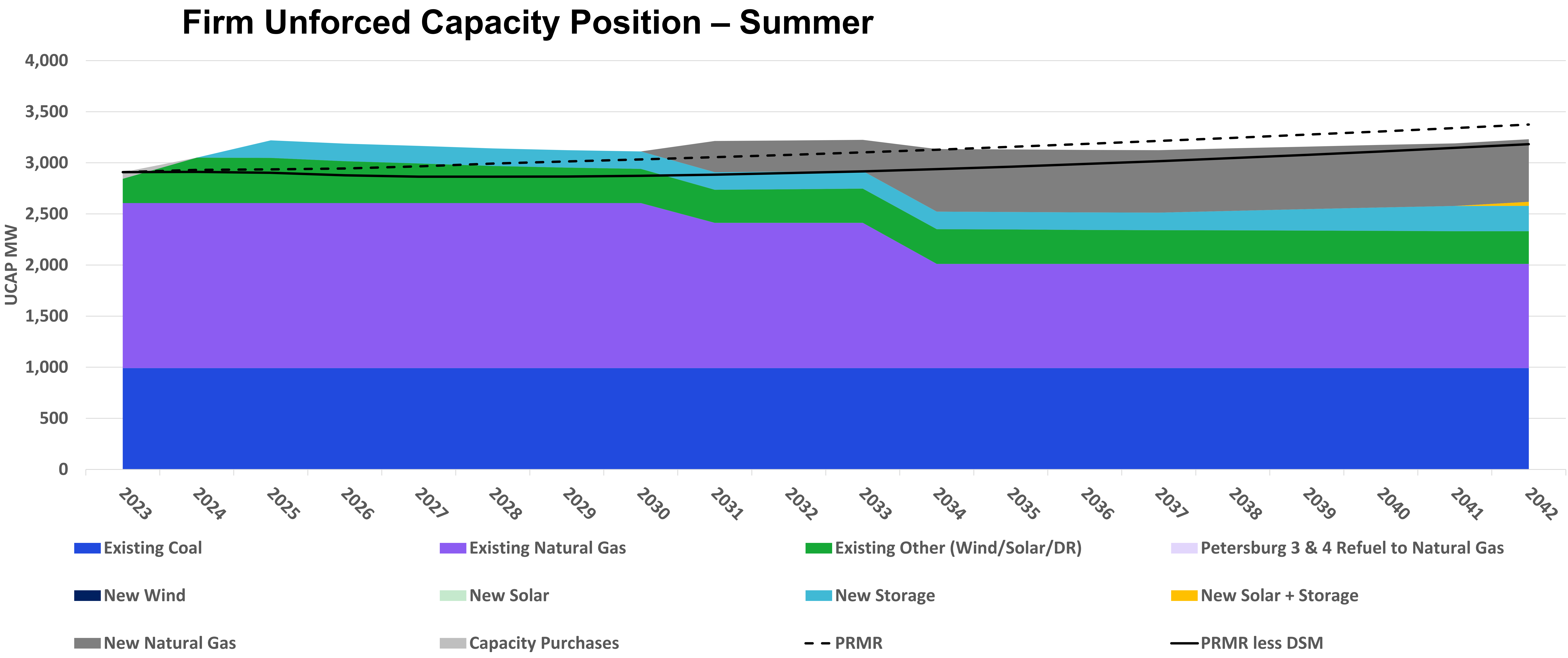
aes Indiana

# A. No Early Retirement

**Generation Strategy:**
***No Early Retirement***

| Scenarios | | | |
| --- | --- | --- | --- |
| No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| $7,111 | | | |

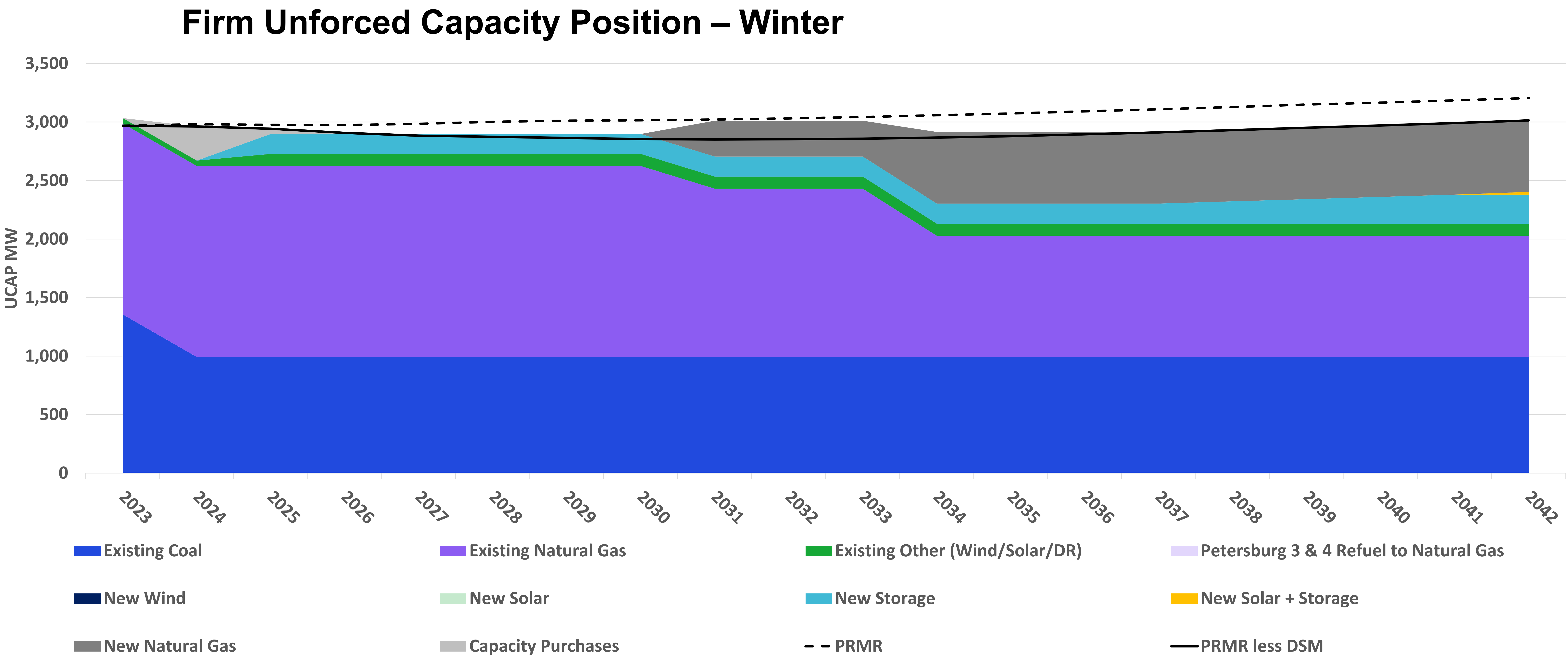
# No Early Retirement: No Environmental Action



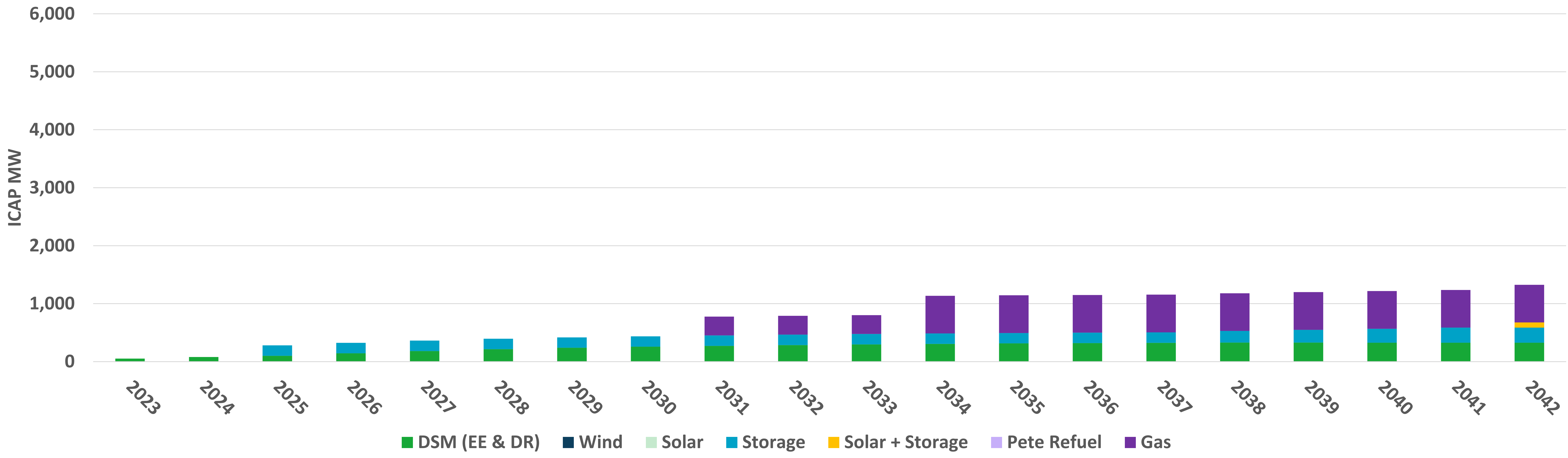



AES Indiana

# No Early Retirement: No Environmental Action



# **No Early Retirement:** No Environmental Action



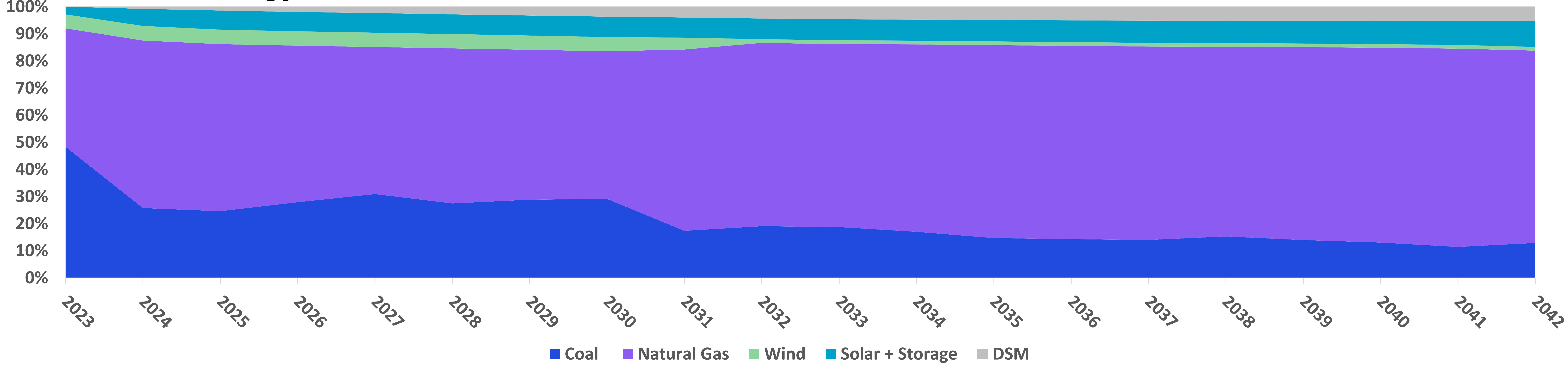

## *Installed Capacity Incremental Additions (MW): 2023 - 2028*

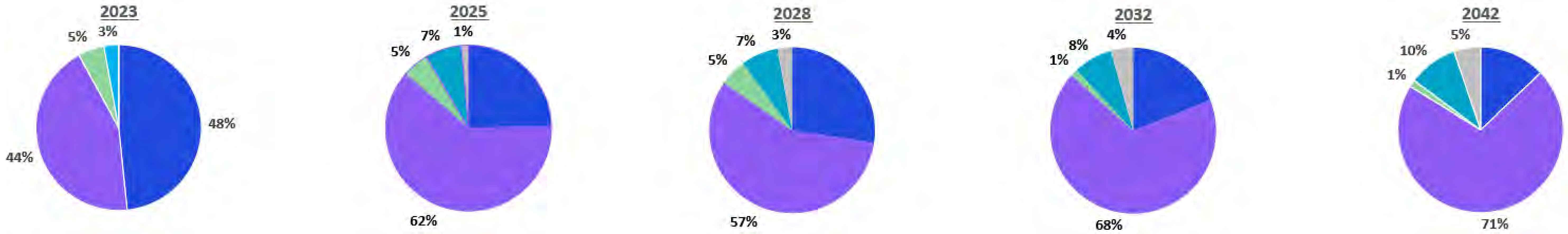
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 180 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 0 | 0 | 0 | 0 |
| Pete Refuel | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |



AES Indiana

# Energy Mix %




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 86% | Thermal MWh % | 85% | Thermal MWh % | 87% | Thermal MWh % | 84% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 14% | Renewable/DSM MWh % | 15% | Renewable/DSM MWh % | 13% | Renewable/DSM MWh % | 16% |

# No Early Retirement: No Environmental Action

## *Current Trends PVRR Summary*

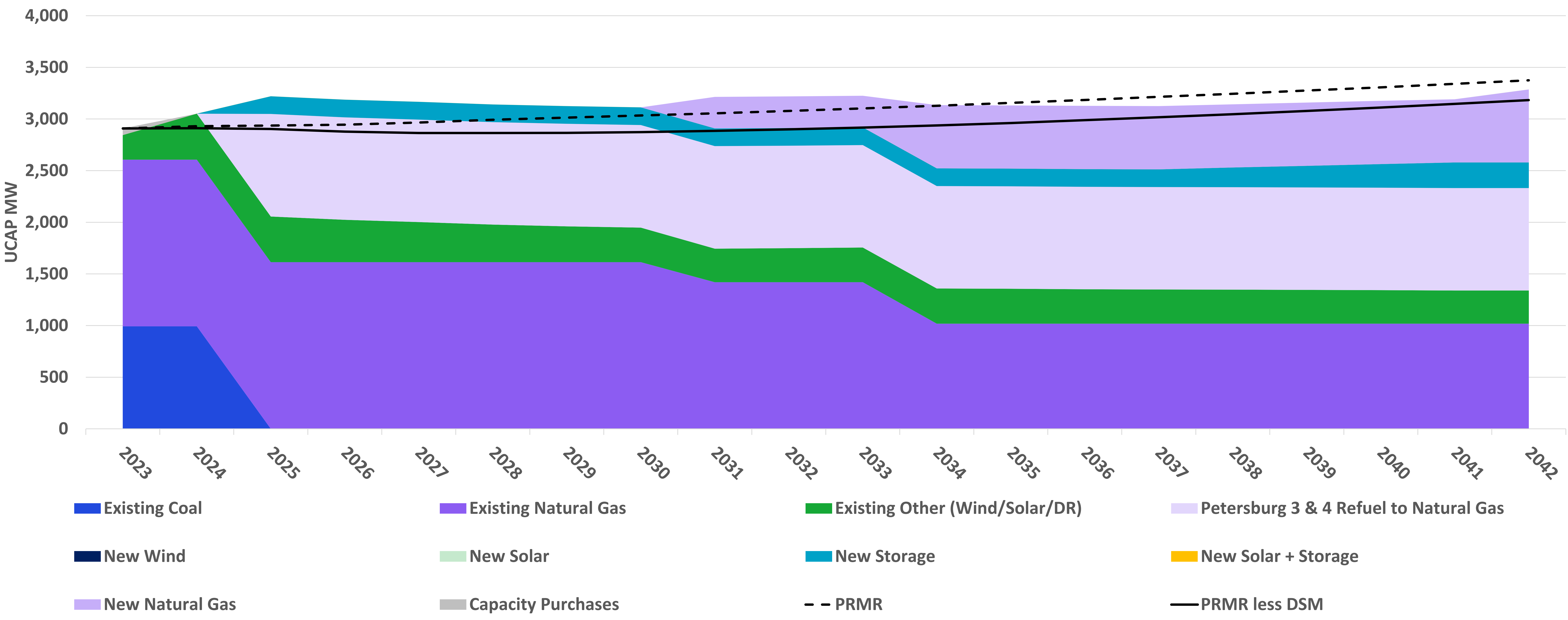
*20-Year PVRR (2023$MM, 2023-2042)*

| | Scenarios |
|---|---|
| | No Environmental Action |
| No Early Retirement | **$7,111** |
| Pete Refuel to 100% Gas (est. 2025) | $6,621 |
| One Pete Unit Retires (2026) | $7,462 |
| Both Pete Units Retire (2026 & 2028) | $7,425 |
| "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | $9,211 |
| Encompass Optimization without predefined Strategy | $6,610 |

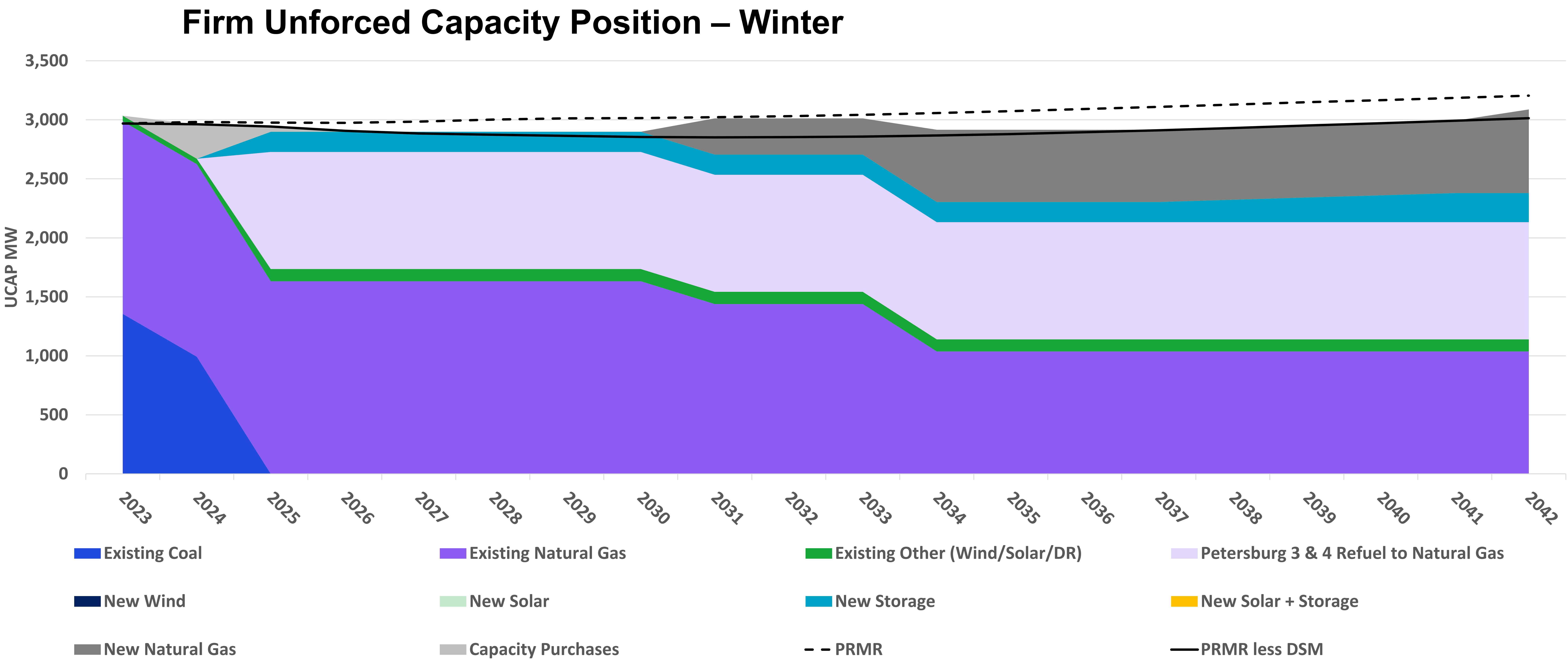
# B. Pete Refuel by 2025

| *20-Year PVRR (2023$MM, 2023-2042)* | Scenarios | | | |
|---|---|---|---|---|
| | **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| **Generation Strategy:** *Pete Refuel to 100% Gas (est. 2025)* | **$6,621** | | | |

# Pete 3 & 4 Refuel in 2025: No Environmental Action



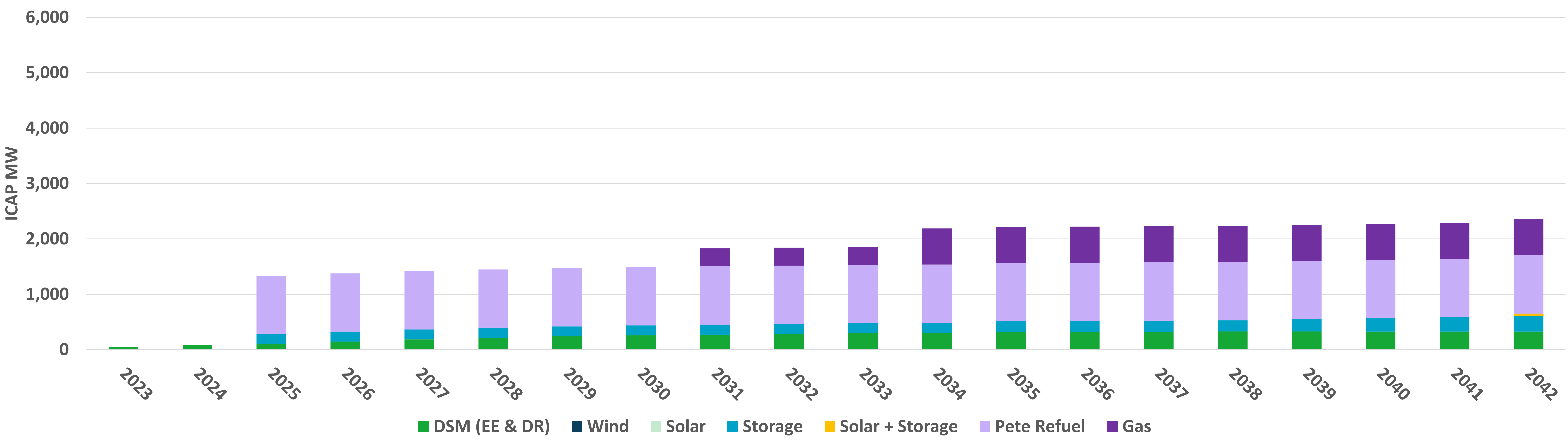
# Pete 3 & 4 Refuel in 2025: No Environmental Action






aes Indiana

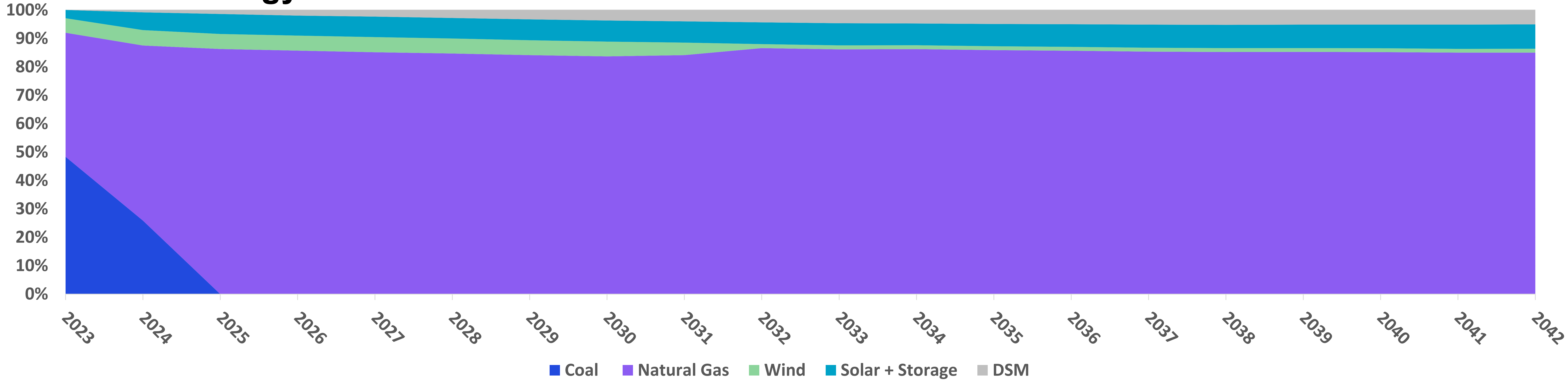
# Pete 3 & 4 Refuel in 2025: No Environmental Action

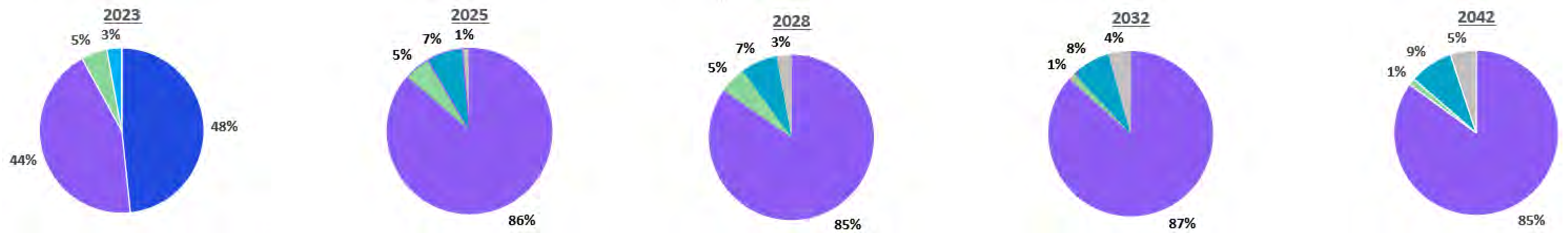



***Installed Capacity Incremental Additions (MW): 2023 - 2028***

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 180 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 0 | 0 | 0 | 0 |
| Pete Refuel | 0 | 0 | 1,052 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |

# Energy Mix %




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 86% | Thermal MWh % | 85% | Thermal MWh % | 87% | Thermal MWh % | 85% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 14% | Renewable/DSM MWh % | 15% | Renewable/DSM MWh % | 13% | Renewable/DSM MWh % | 15% |

# Pete 3 & 4 Refuel in 2025: No Environmental Action

## Portfolio Overview

### *Retirements*

Petersburg:
- Pete 3 & 4 Coal: 2025 Refuel with Nat Gas
  - **Total Refueled MW: 1,040 MW**

Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 326 MW
- Wind: 0 MW
- Solar: 0 MW
- Storage: 260 MW
- Solar + Storage: 0 MW
- Thermal: 750 MW
- Pete 3 & 4 Refueled to Nat Gas: 1,052 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | **No Environmental Action** |
| **No Early Retirement** | $7,111 |
| **Pete Refuel to 100% Gas (est. 2025)** | **$6,621** |
| **One Pete Unit Retires (2026)** | $7,462 |
| **Both Pete Units Retire (2026 & 2028)** | $7,425 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,211 |
| **Encompass Optimization without predefined Strategy** | $6,610 |



aes Indiana

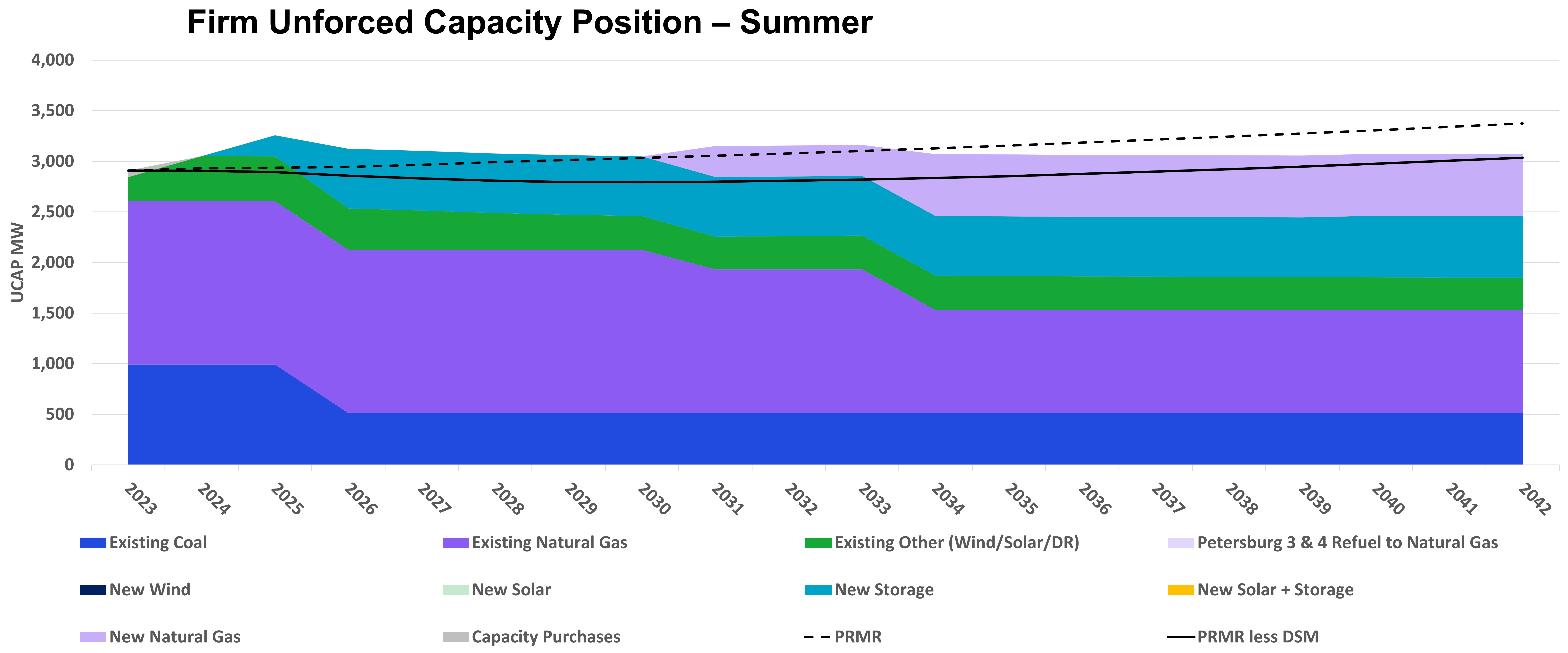
# C. One Pete Unit Retires (2026)

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

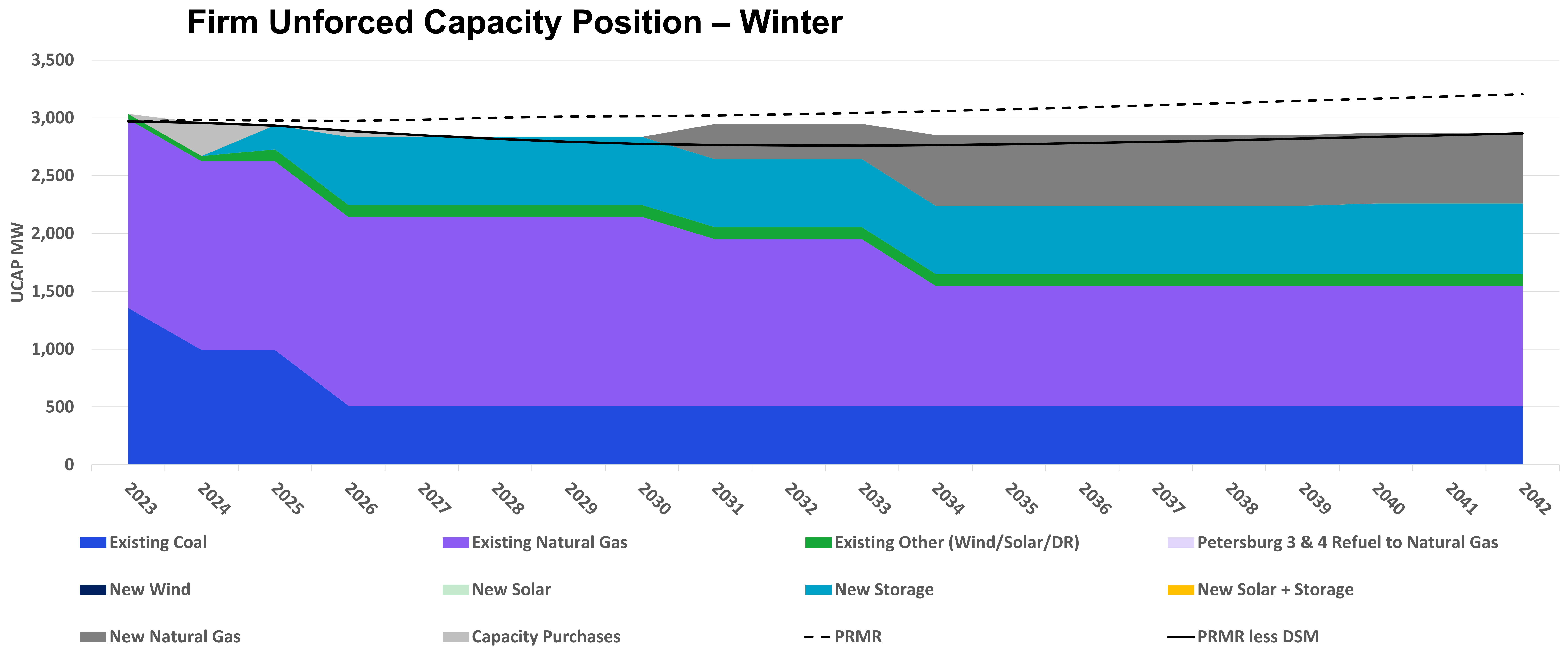
**Generation Strategy:** *One Pete Unit Retires (2026)*

| Scenarios | | | |
|---|---|---|---|
| **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| **$7,462** | | | |

# One Pete Unit Retires (2026): No Environmental Action



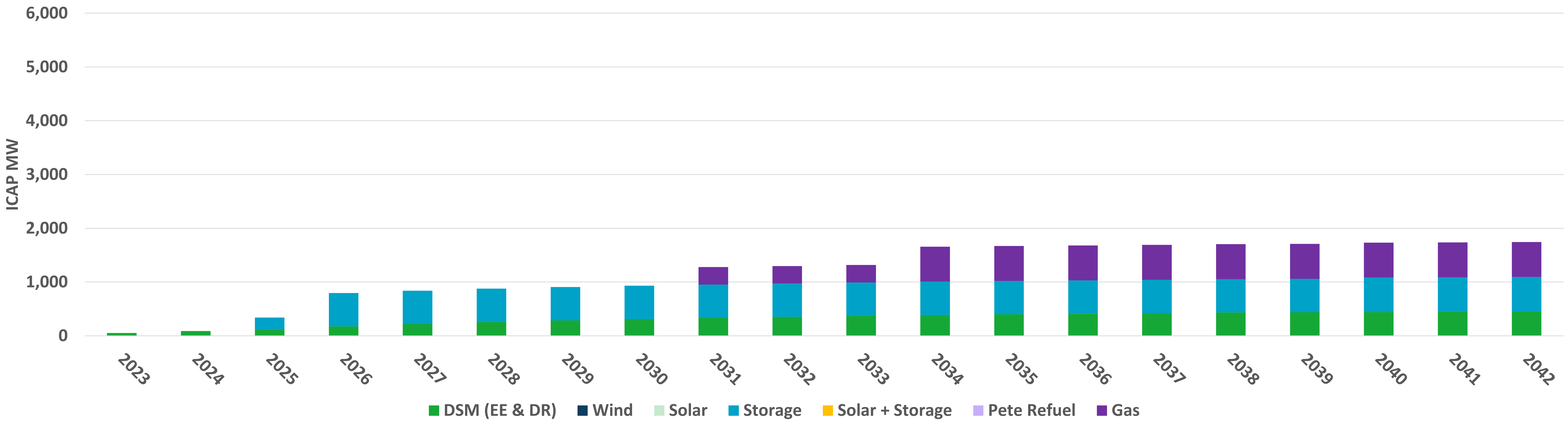
# One Pete Unit Retires (2026): No Environmental Action






aes Indiana

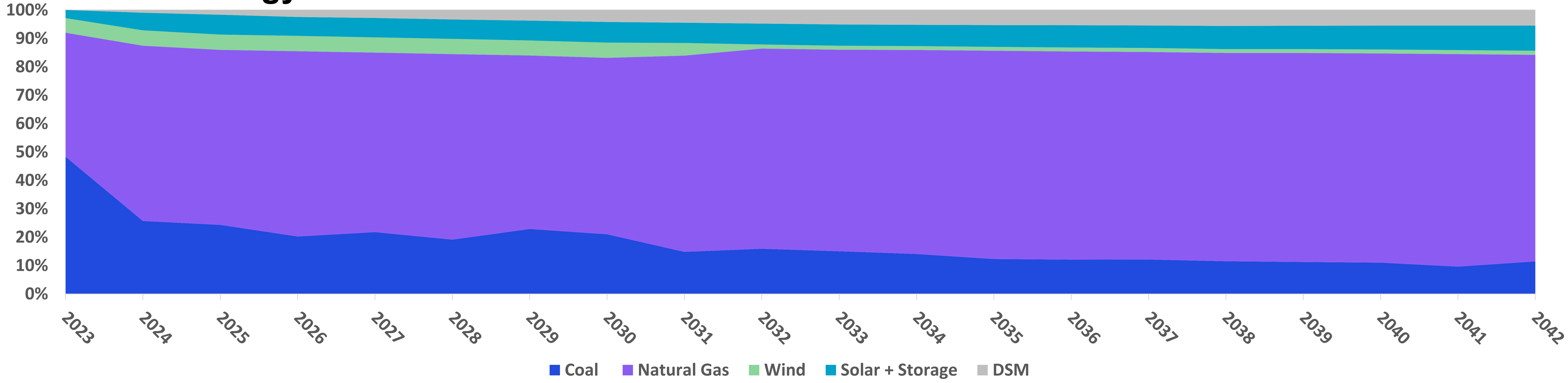
# One Pete Unit Retires (2026): No Environmental Action

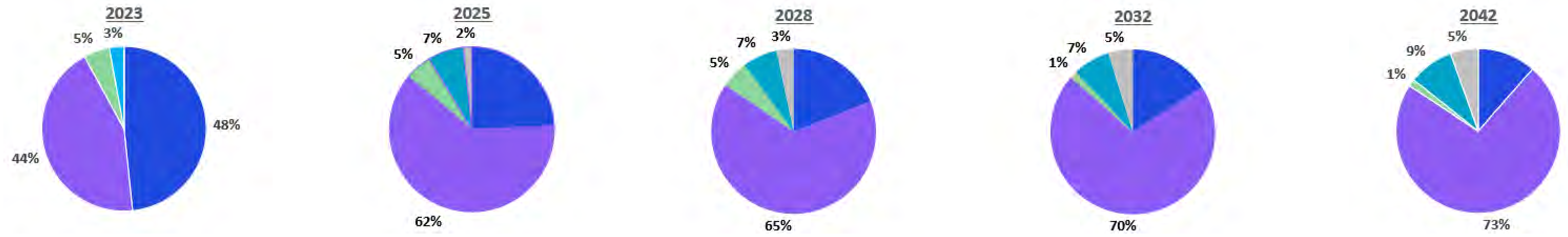



***Installed Capacity Incremental Additions (MW): 2023 - 2028***

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 220 | 400 | 0 | 0 |
| Solar + Storage | 0 | 0 | 0 | 0 | 0 | 0 |
| Pete Refuel | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |

# Energy Mix %




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 86% | Thermal MWh % | 84% | Thermal MWh % | 86% | Thermal MWh % | 84% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 14% | Renewable/DSM MWh % | 16% | Renewable/DSM MWh % | 14% | Renewable/DSM MWh % | 16% |

# One Pete Unit Retires (2026): No Environmental Action

## Portfolio Overview

### *Retirements*

Petersburg:
- Pete 3 Coal: 2026
  - **Total Coal Retired MW: 520 MW**

Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 453 MW
- Wind: 0 MW
- Solar: 0 MW
- Storage: 640 MW
- Solar + Storage: 0 MW
- Thermal: 650 MW

### *Current Trends PVRR Summary*

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

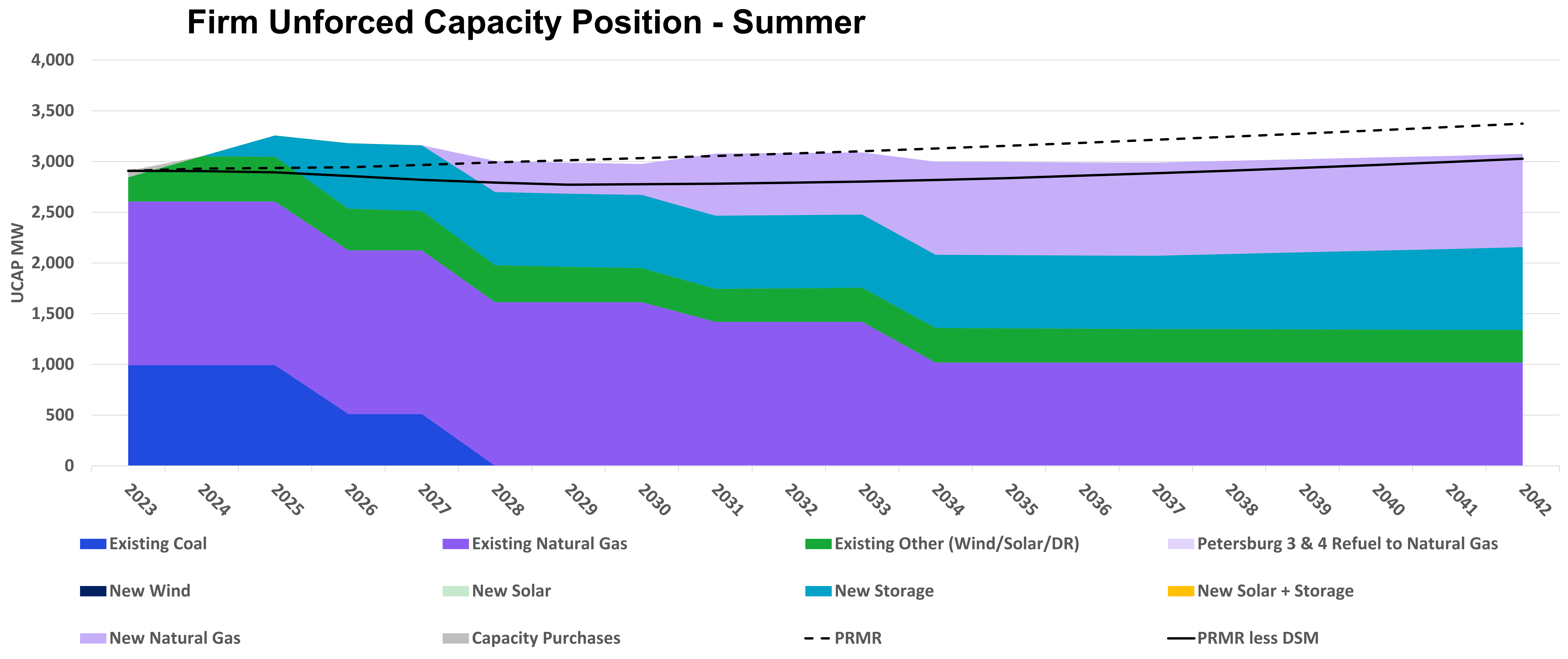
| | Scenarios |
|---|---|
| | **No Environmental Action** |
| **No Early Retirement** | $7,111 |
| **Pete Refuel to 100% Gas (est. 2025)** | $6,621 |
| **One Pete Unit Retires (2026)** | **$7,462** |
| **Both Pete Units Retire (2026 & 2028)** | $7,425 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,211 |
| **Encompass Optimization without predefined Strategy** | $6,610 |

# D. Both Pete Units Retire (2026 & 2028)

| 20-Year PVRR (2023$MM, 2023-2042) | Scenarios | | | |
|---|---|---|---|---|
| | No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| Generation Strategy: Both Pete Units Retire (2026 & 2028) | $7,425 | | | |

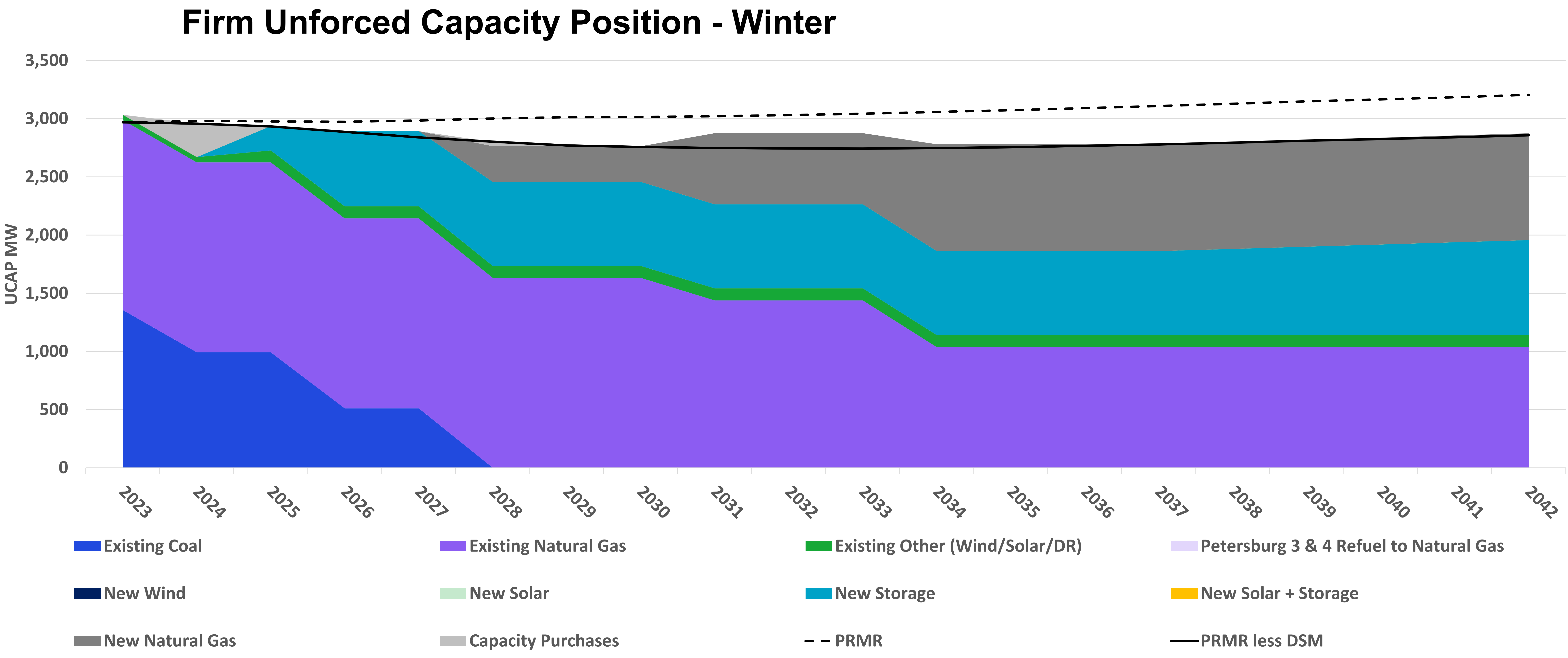
# Both Pete Units Retire: No Environmental Action

*2026 & 2028*



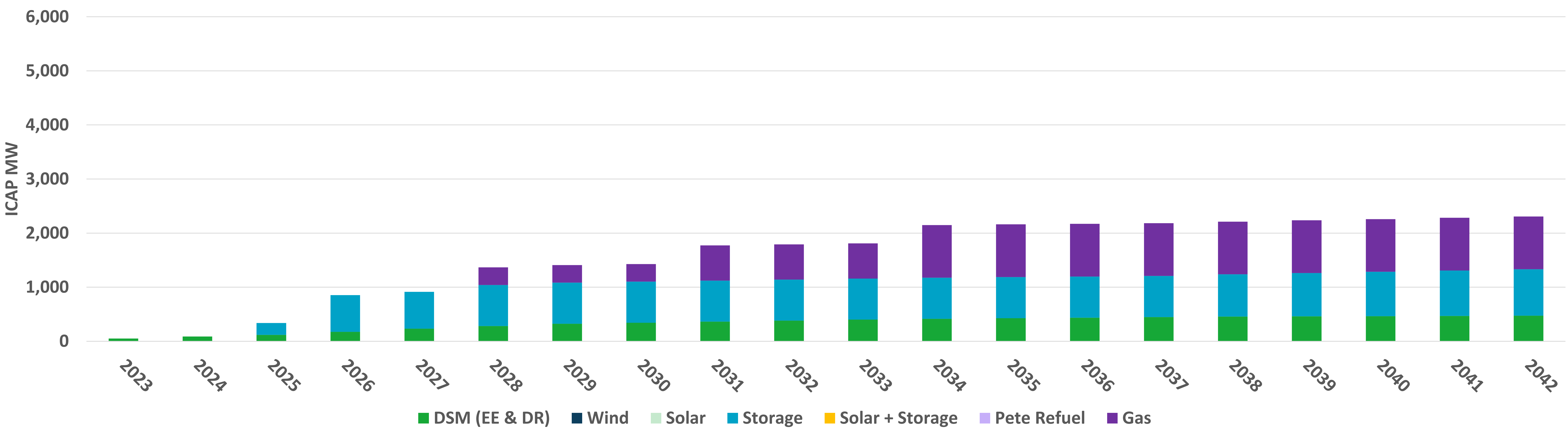
# Both Pete Units Retire: No Environmental Action

*2026 & 2028*



# **Both Pete Units Retire:** No Environmental Action

***2026 & 2028***

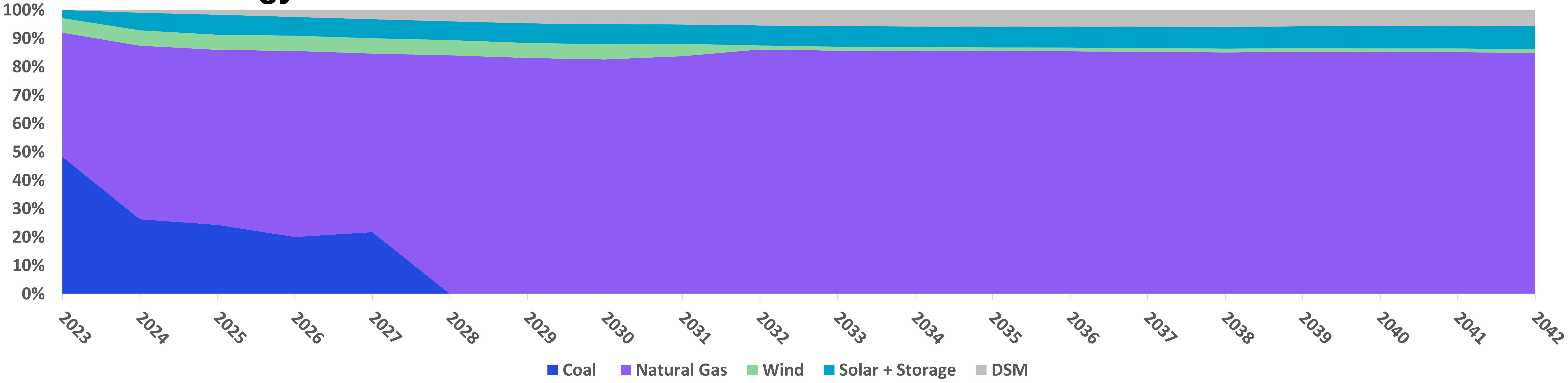


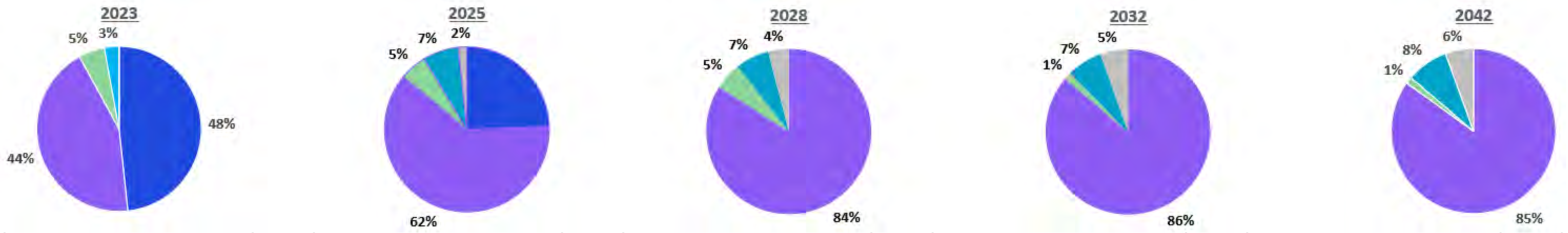

***Installed Capacity Incremental Additions (MW): 2023 – 2028***

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 220 | 460 | 0 | 80 |
| Solar + Storage | 0 | 0 | 0 | 0 | 0 | 0 |
| Pete Refuel | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 325 |

## 2026 & 2028

# Energy Mix %




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 86% | Thermal MWh % | 84% | Thermal MWh % | 86% | Thermal MWh % | 85% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 14% | Renewable/DSM MWh % | 16% | Renewable/DSM MWh % | 14% | Renewable/DSM MWh % | 15% |

# Both Pete Units Retire: No Environmental Action

*2026 & 2028*

## Portfolio Overview

### *Retirements*

Petersburg:

- Pete 3 Coal: 2026
- Pete 4 Coal: 2028
  - **Total Coal Retired MW: 1,040 MW**

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 472 MW
- Wind: 0 MW
- Solar: 0 MW
- Storage: 860 MW
- Solar + Storage: MW
- Thermal: 975 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | **No Environmental Action** |
| **No Early Retirement** | $7,111 |
| **Pete Refuel to 100% Gas (est. 2025)** | $6,621 |
| **One Pete Unit Retires (2026)** | $7,462 |
| **Both Pete Units Retire (2026 & 2028)** | **$7,425** |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,211 |
| **Encompass Optimization without predefined Strategy** | $6,610 |



AES Indiana

# Retire & Replace Pete with Clean Energy

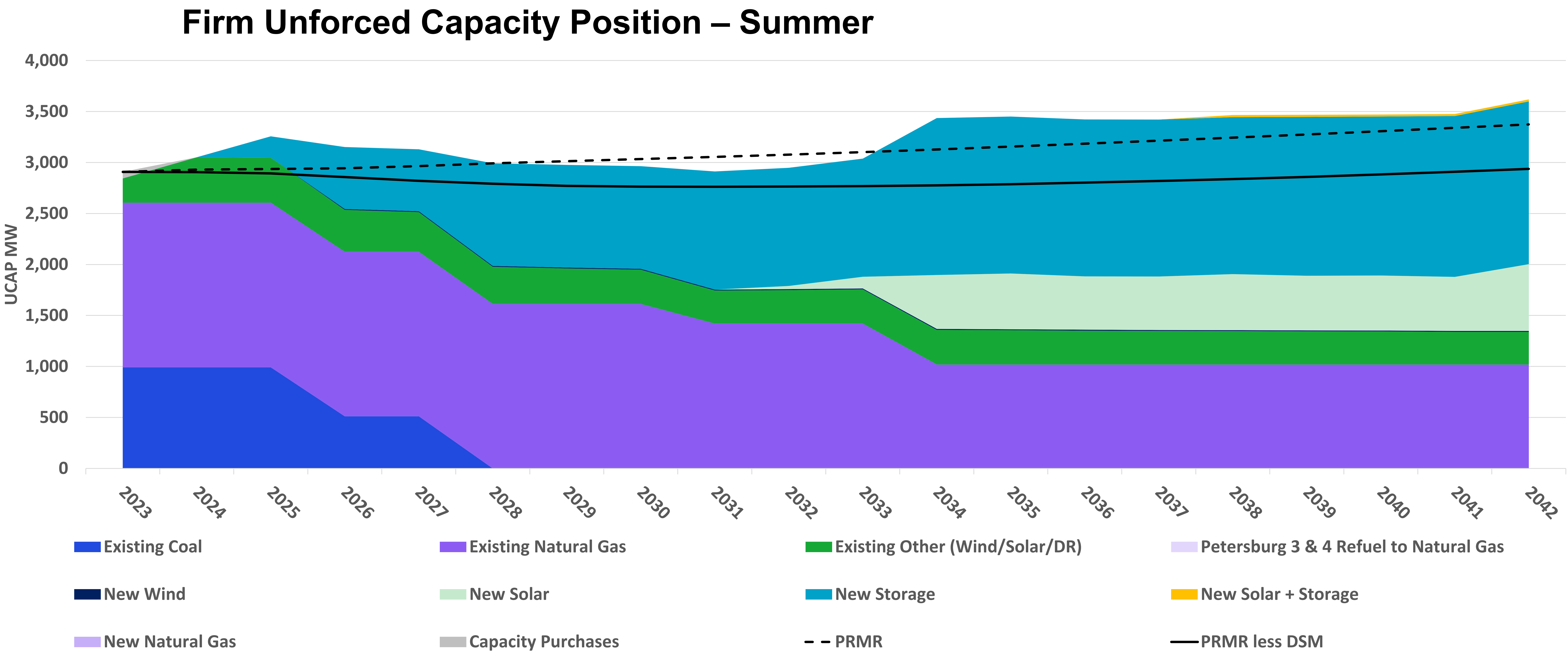
| *20-Year PVRR (2023$MM, 2023-2042)* | Scenarios | | | |
|---|---|---|---|---|
| | **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| **Generation Strategy:** *"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)* | **$9,211** | | | |



aes Indiana

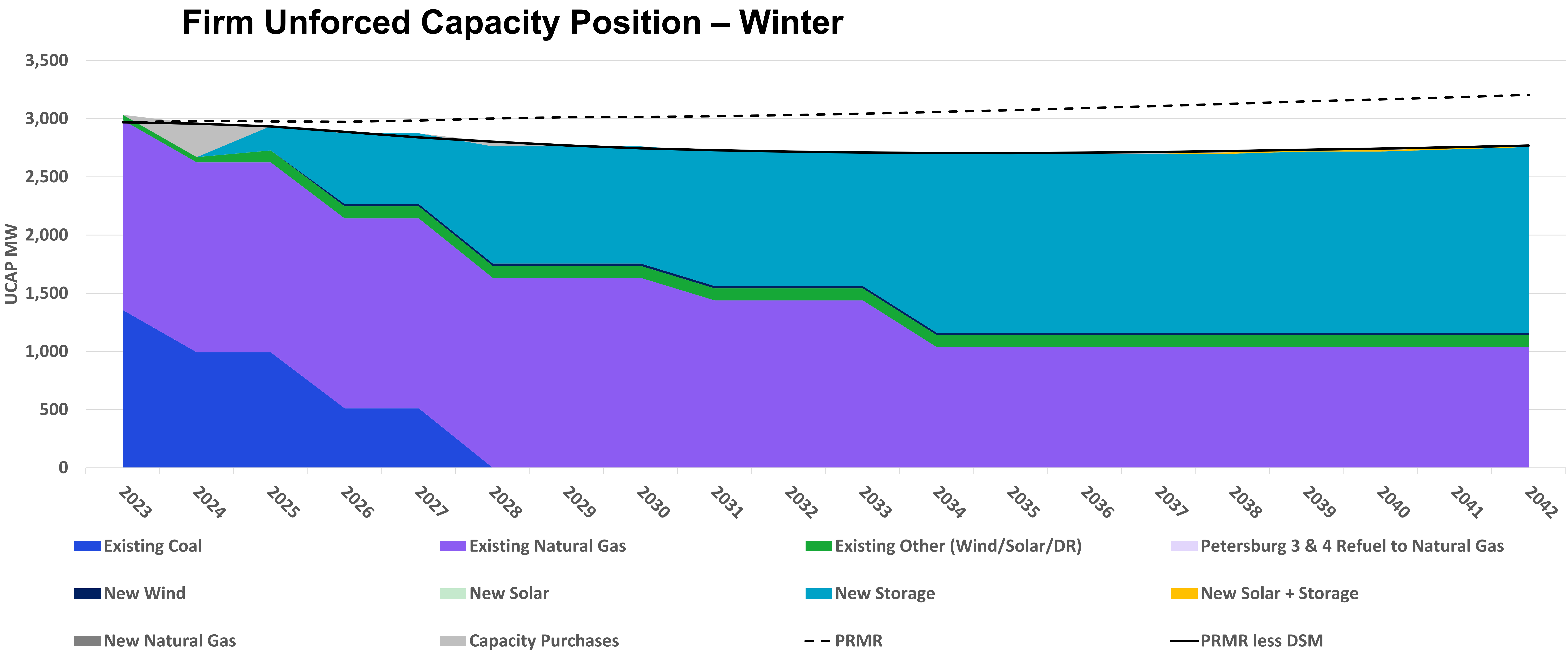
# Clean Energy Strategy: No Environmental Action

*Retire & Replace Pete with Clean Energy*



# Clean Energy Strategy: Decarbonized Economy

***Retire & Replace Pete with Clean Energy***



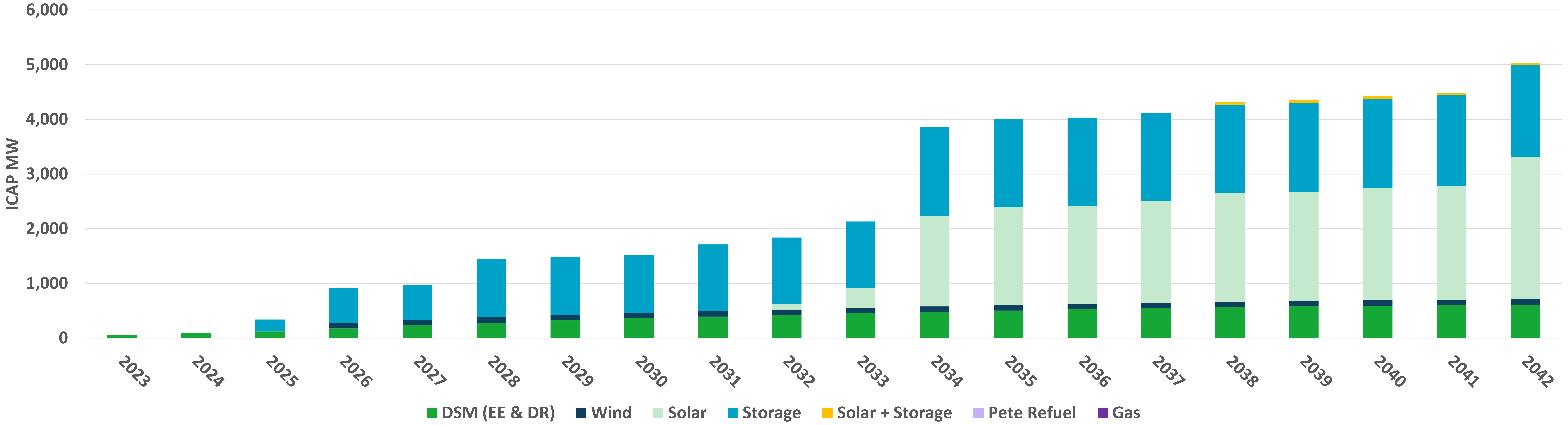





aes Indiana

# Clean Energy Strategy: Decarbonized Economy

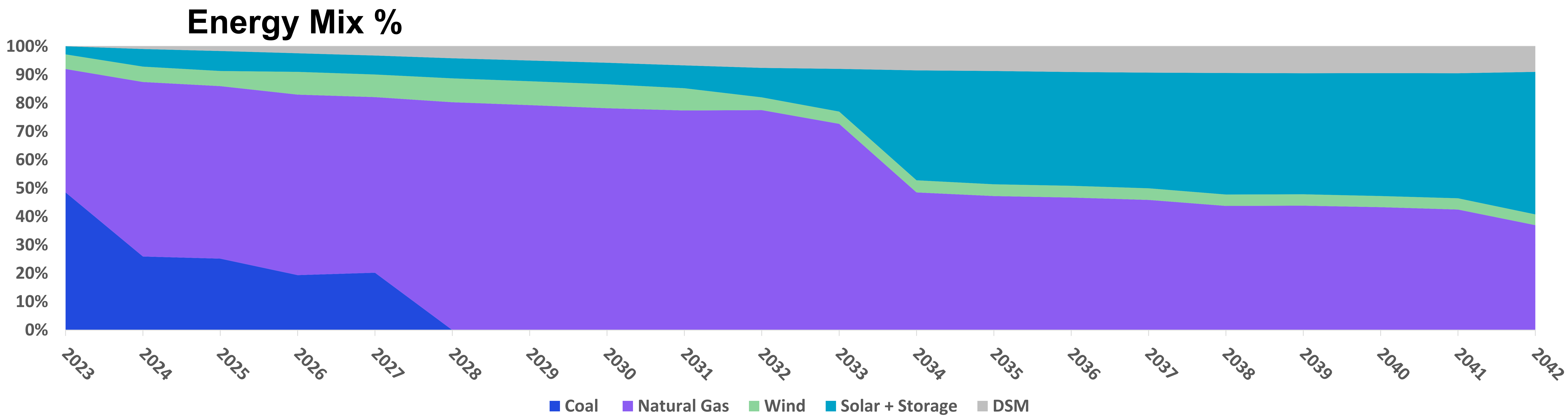
***Retire & Replace Pete with Clean Energy***

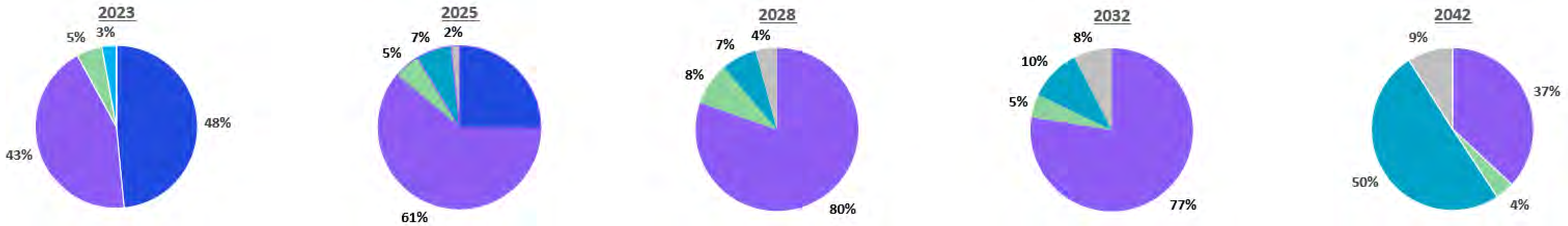



***Installed Capacity Incremental Additions (MW): 2023 – 2028***

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 100 | 0 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 220 | 420 | 0 | 420 |
| Solar + Storage | 0 | 0 | 0 | 0 | 0 | 0 |
| Pete Refuel | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |

# Clean Energy Strategy: Decarbonized Economy




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 86% | Thermal MWh % | 80% | Thermal MWh % | 77% | Thermal MWh % | 37% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 14% | Renewable/DSM MWh % | 20% | Renewable/DSM MWh % | 23% | Renewable/DSM MWh % | 63% |

# Clean Energy Strategy: Decarbonized Economy

*Retire & Replace Pete with Clean Energy*

**Portfolio Overview**

## *Retirements*

Petersburg:
- Pete 3 Coal: 2026
- Pete 4 Coal: 2028
  - **Total Coal Retired MW: 1,040 MW**

Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Retired Nat Gas MW: 618 MW**

## *Replacements by 2042*

- DSM: 610 MW
- Wind: 100 MW
- Solar: 2,600 MW
- Storage: 1,680 MW
- Solar + Storage: 45 MW
- Thermal: 0 MW

## *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | No Environmental Action |
| No Early Retirement | $7,111 |
| Pete Refuel to 100% Gas (est. 2025) | $6,621 |
| One Pete Unit Retires (2026) | $7,462 |
| Both Pete Units Retire (2026 & 2028) | $7,425 |
| "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | **$9,211** |
| Encompass Optimization without predefined Strategy | $6,610 |



AES Indiana

# F. Encompass Optimization

*Refuels Petersburg Units 3 & 4 in 2025*

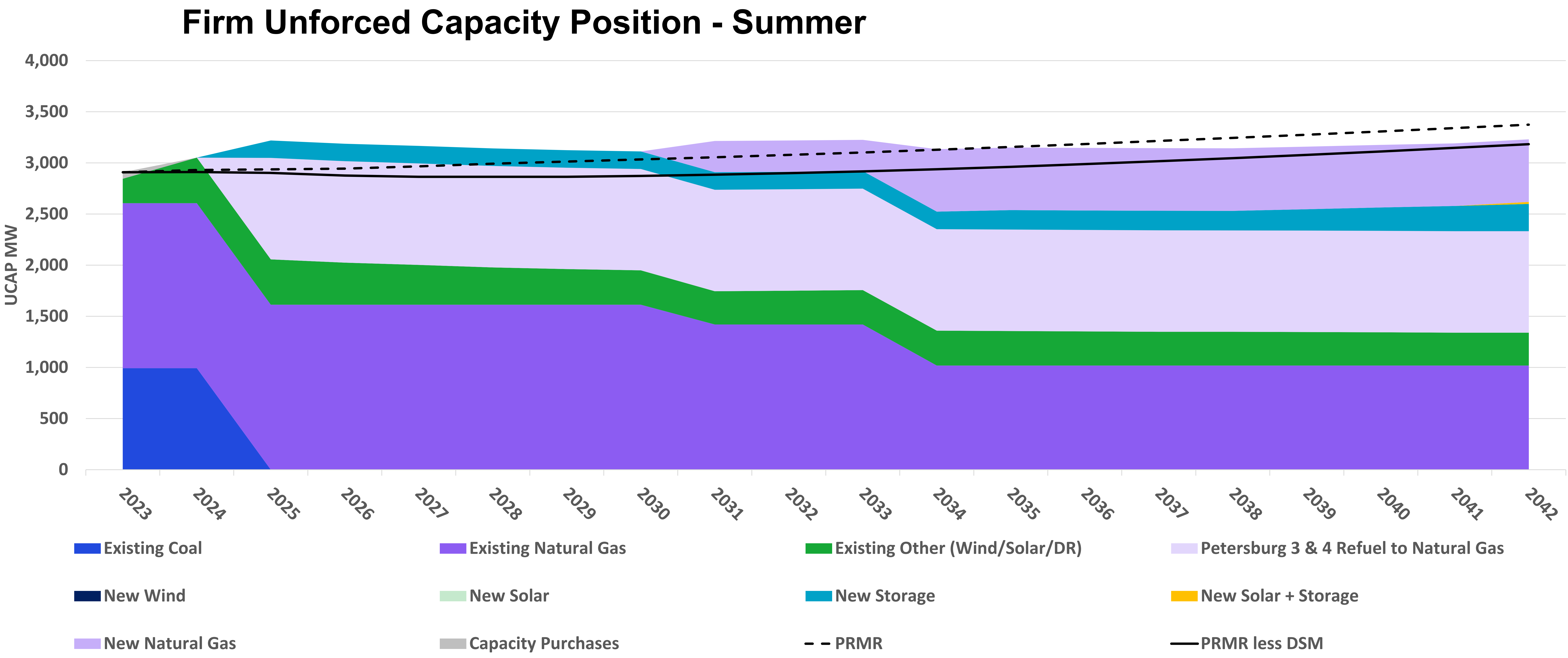
| *20-Year PVRR (2023$MM, 2023-2042)* | Scenarios | | | |
|---|---|---|---|---|
| | No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| **Generation Strategy:** *Encompass Optimization without predefined Strategy – Selects Pete 3 & 4 Refuel in 2025* | **$6,610** | | | |



aes Indiana

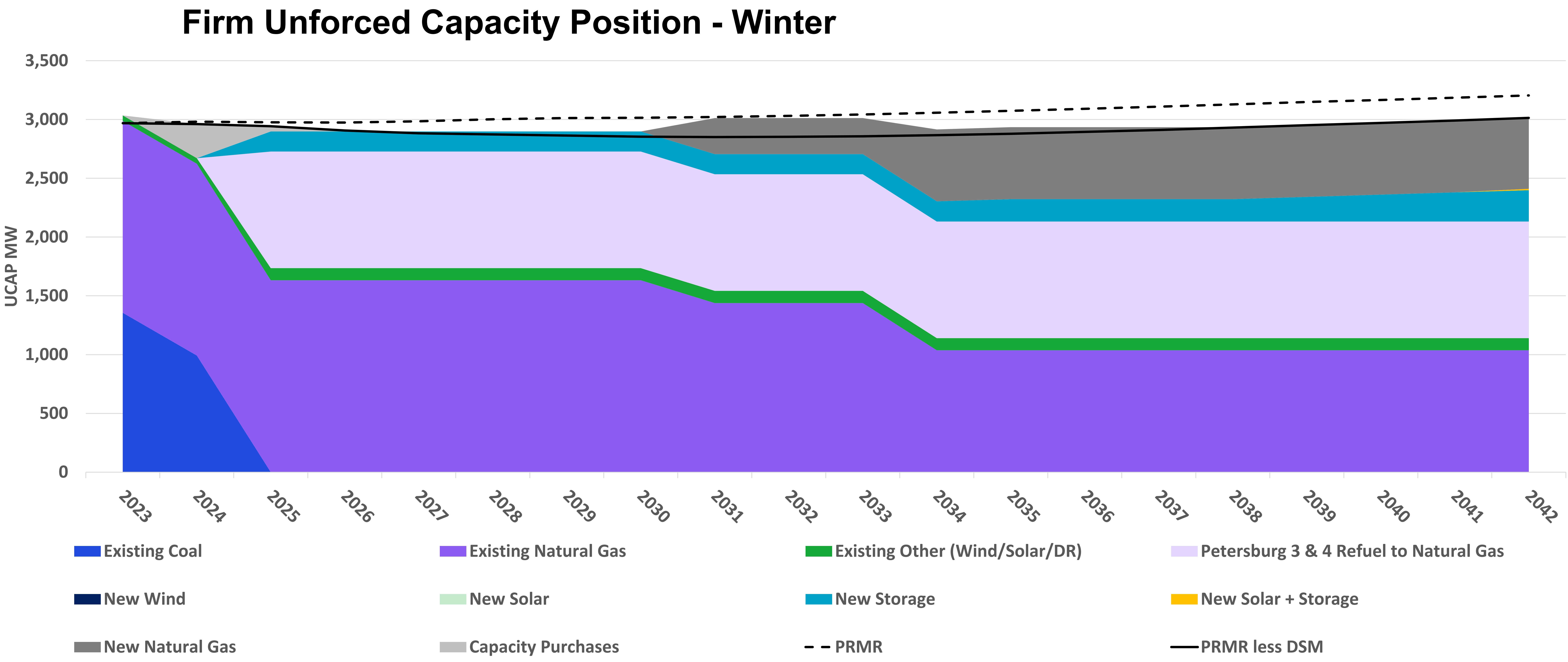
# Encompass Optimization: No Environmental Action

*Refuels Petersburg Units 3 & 4 in 2025*



# Encompass Optimization: No Environmental Action

*Refuels Petersburg Units 3 & 4 in 2025*

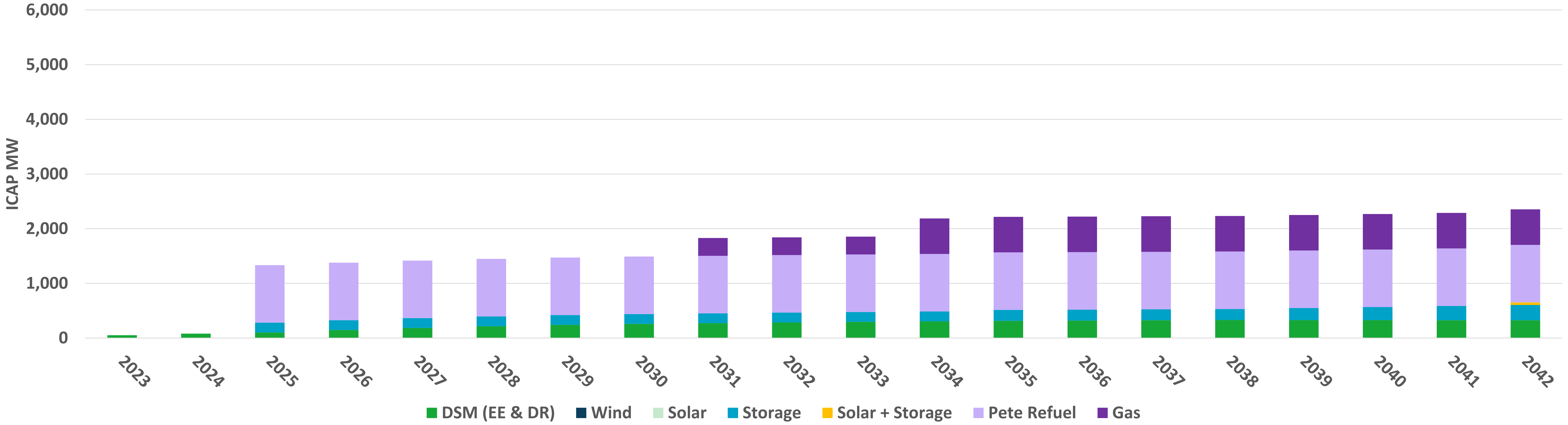





aes Indiana

# Encompass Optimization: No Environmental Action

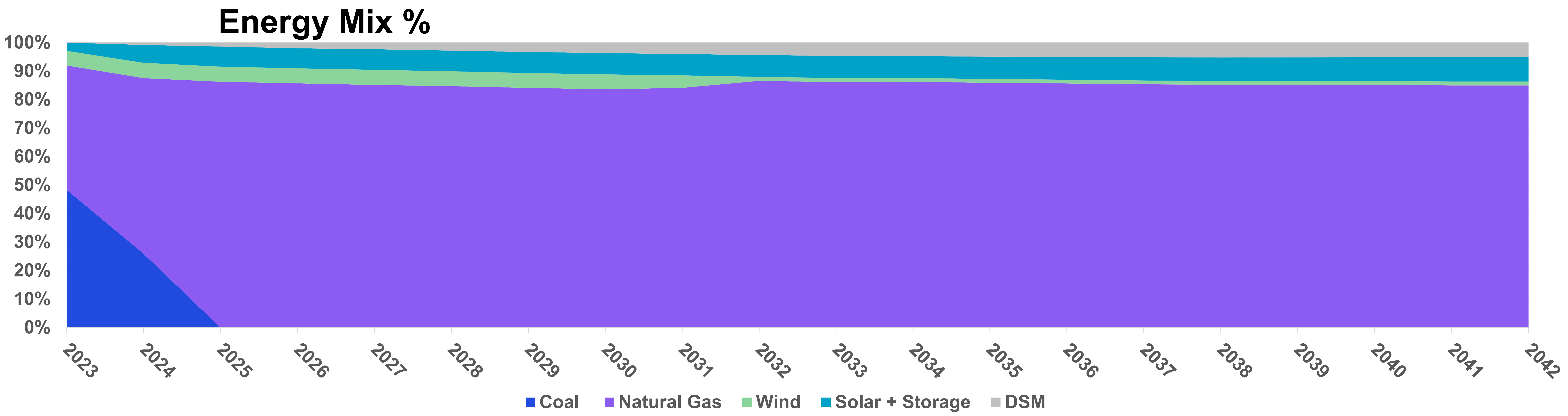
***Refuels Petersburg Units 3 & 4 in 2025***

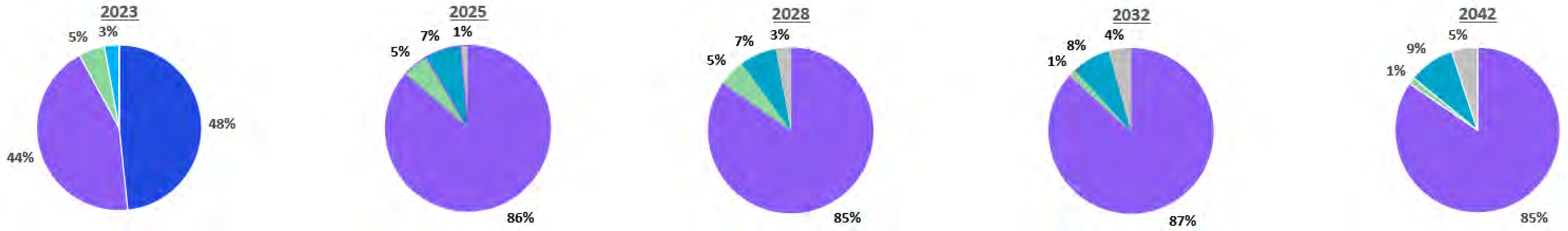



***Installed Capacity Incremental Additions (MW): 2023 - 2028***

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 0 | 0 | 0 |
| Solar | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage | 0 | 0 | 180 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 0 | 0 | 0 | 0 |
| Pete Refuel | 0 | 0 | 1,052 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |

## *Refuels Petersburg Units 3 & 4 in 2025*




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 86% | Thermal MWh % | 85% | Thermal MWh % | 87% | Thermal MWh % | 85% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 14% | Renewable/DSM MWh % | 15% | Renewable/DSM MWh % | 13% | Renewable/DSM MWh % | 15% |

# Encompass Optimization: No Environmental Action

*Refuels Petersburg Units 3 & 4 in 2025*

**Portfolio Overview**

## *Retirements*

Petersburg:
- Pete 3 Coal: 2025
- Pete 4 Coal: 2025
  - **Total Refueled MW: 1,040 MW**

Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

## *Replacement Additions by 2042*

- DSM: 326 MW
- Wind: 0 MW
- Solar: 0 MW
- Storage: 280 MW
- Solar + Storage: 45 MW
- Thermal: 650 MW
- Pete 3 & 4 Refueled to Nat Gas: 1,052 MW

## *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | **No Environmental Action** |
| **No Early Retirement** | $7,111 |
| **Pete Refuel to 100% Gas (est. 2025)** | $6,621 |
| **One Pete Unit Retires (2026)** | $7,462 |
| **Both Pete Units Retire (2026 & 2028)** | $7,425 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,211 |
| **Encompass Optimization without predefined Strategy** | **$6,610** |



AES Indiana

# Portfolio Matrix

| *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 Unit 3 in 2025 & Refuels Petersburg Unit 4 in 2027 | Refuels Petersburg Unit 4 in 2027 | Refuels Petersburg Unit 3 in 2025 & Refuels Petersburg Unit 4 in 2027 |



aes Indiana

# Decarbonized Economy

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

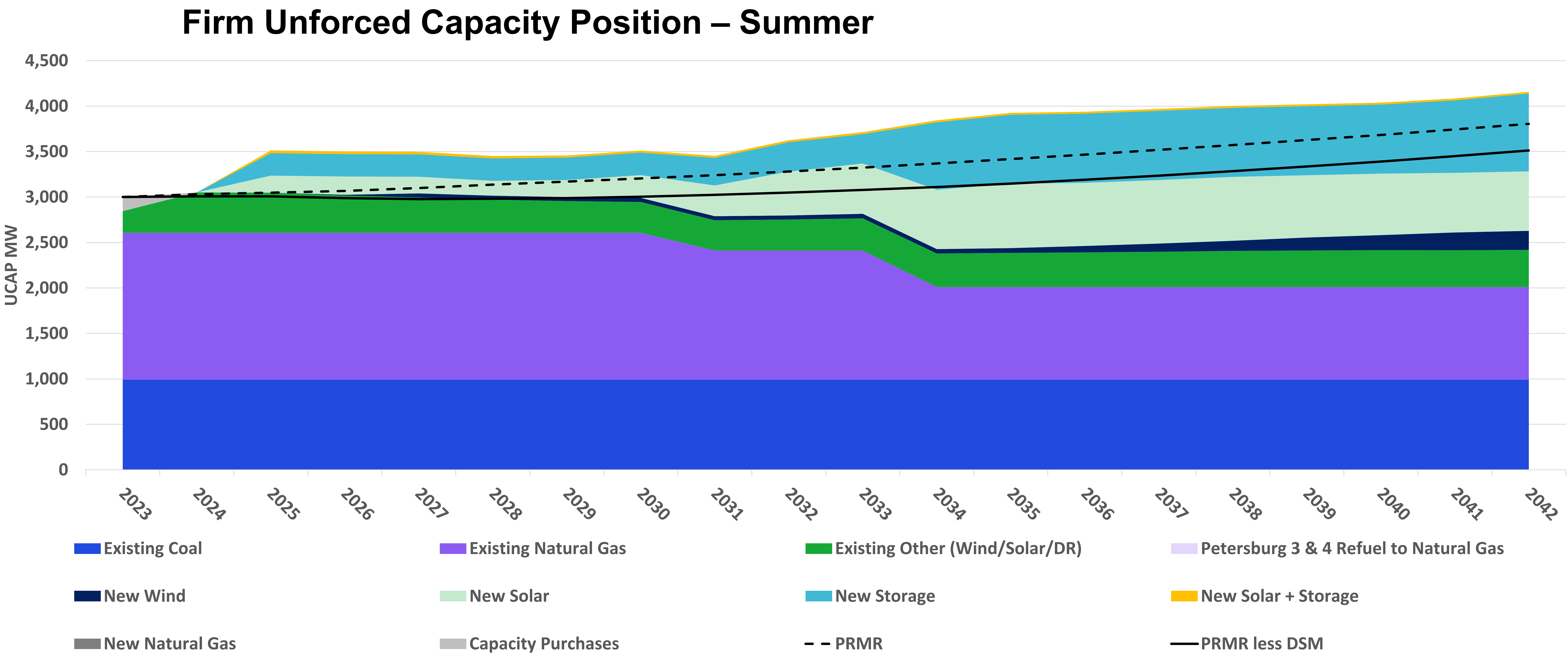
| | | Scenarios |
|---|---|---|
| | | Decarbonized Economy |
| Generation Strategies | No Early Retirement | $9,917 |
| | Pete Refuel to 100% Gas (est. 2025) | $9,546 |
| | One Pete Unit Retires (2026) | $9,955 |
| | Both Pete Units Retire (2026 & 2028) | $9,923 |
| | "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | $9,690 |
| | Encompass Optimization without predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027 | $9,572 |

# A. No Early Retirement

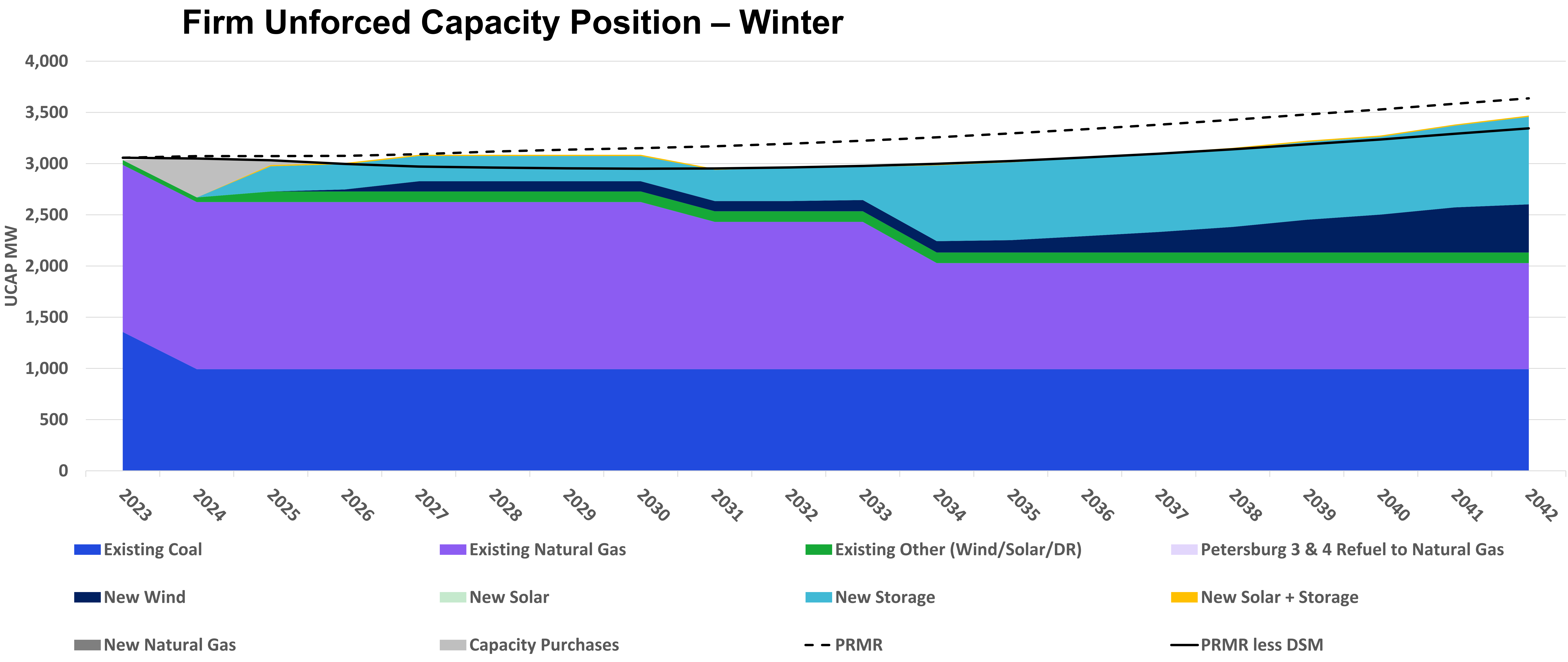
**Generation Strategy:**
***No Early Retirement***

| Scenarios | | | |
|---|---|---|---|
| No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| | | | $9,917 |

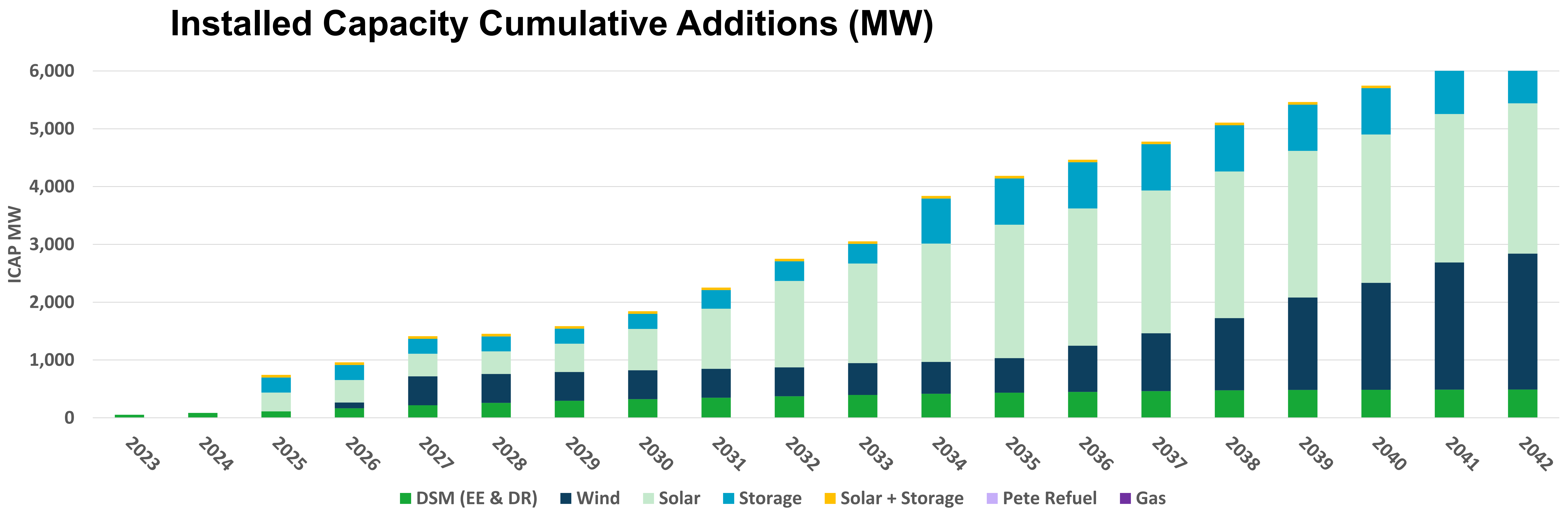
# No Early Retirement: Decarbonized Economy



# No Early Retirement: Decarbonized Economy



# No Early Retirement: Decarbonized Economy




***Installed Capacity Incremental Additions (MW): 2023 - 2028***

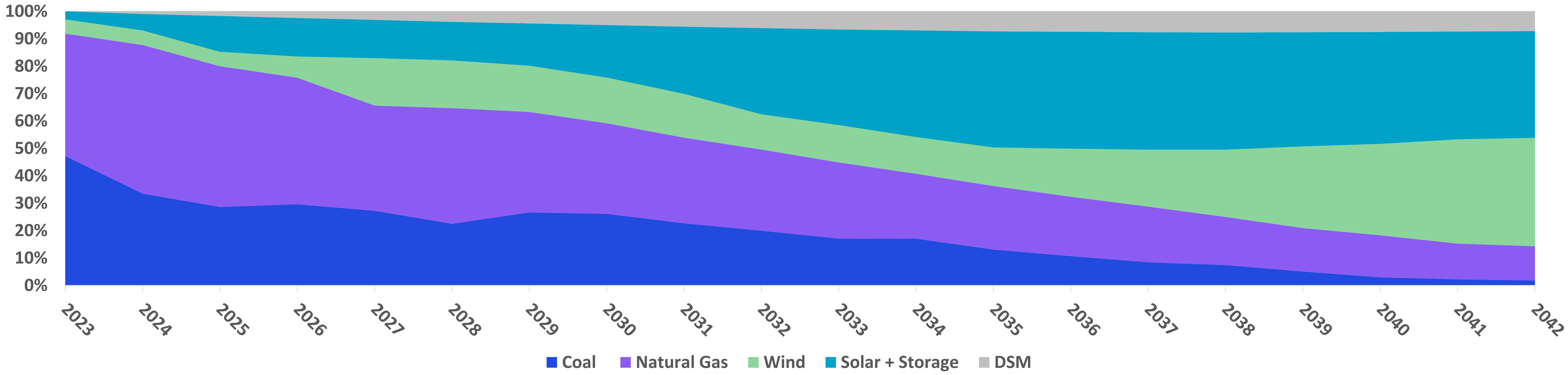
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 100 | 400 | 0 |
| Solar | 0 | 0 | 325 | 65 | 0 | 0 |
| Storage | 0 | 0 | 260 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |

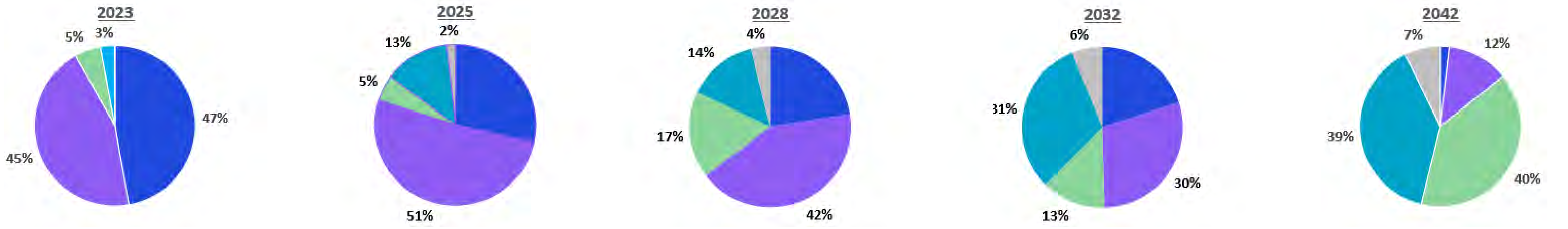


aes Indiana

# No Early Retirement: Decarbonized Economy

## Energy Mix %




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 80% | Thermal MWh % | 65% | Thermal MWh % | 50% | Thermal MWh % | 14% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 20% | Renewable/DSM MWh % | 35% | Renewable/DSM MWh % | 50% | Renewable/DSM MWh % | 86% |

# **No Early Retirement:** Decarbonized Economy

**Portfolio Overview**

***Retirements***

Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

***Replacement Additions by 2042***
- DSM: 490 MW
- Wind: 2,350 MW
- Solar: 2,600 MW
- Storage: 900 MW
- Solar + Storage: 45 MW
- Thermal: 0 MW

***Current Trends PVRR Summary***

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

| | Scenarios |
|---|---|
| | Decarbonized Economy |
| No Early Retirement | $9,917 |
| Pete Refuel to 100% Gas (est. 2025) | $9,546 |
| One Pete Unit Retires (2026) | $9,955 |
| Both Pete Units Retire (2026 & 2028) | $9,923 |
| "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | $9,690 |
| Encompass Optimization without predefined Strategy | $9,572 |

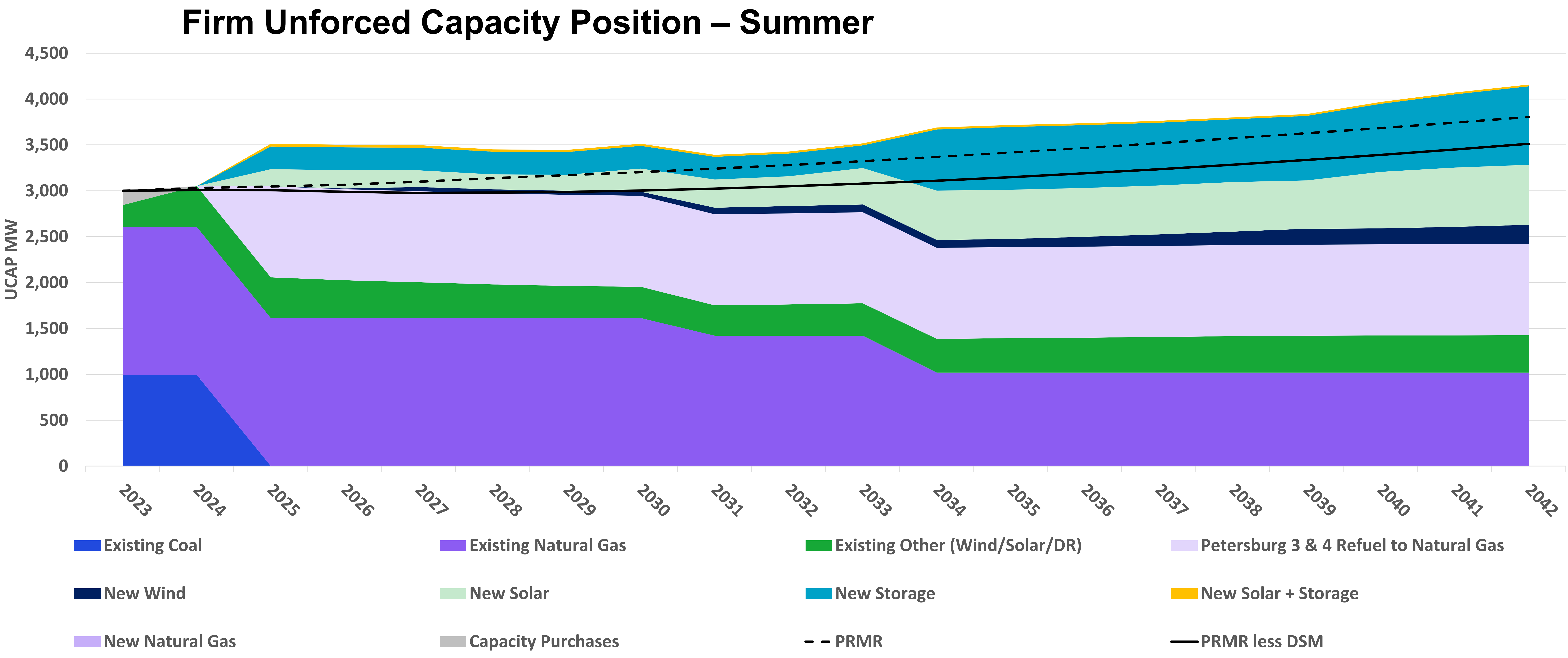


aes Indiana

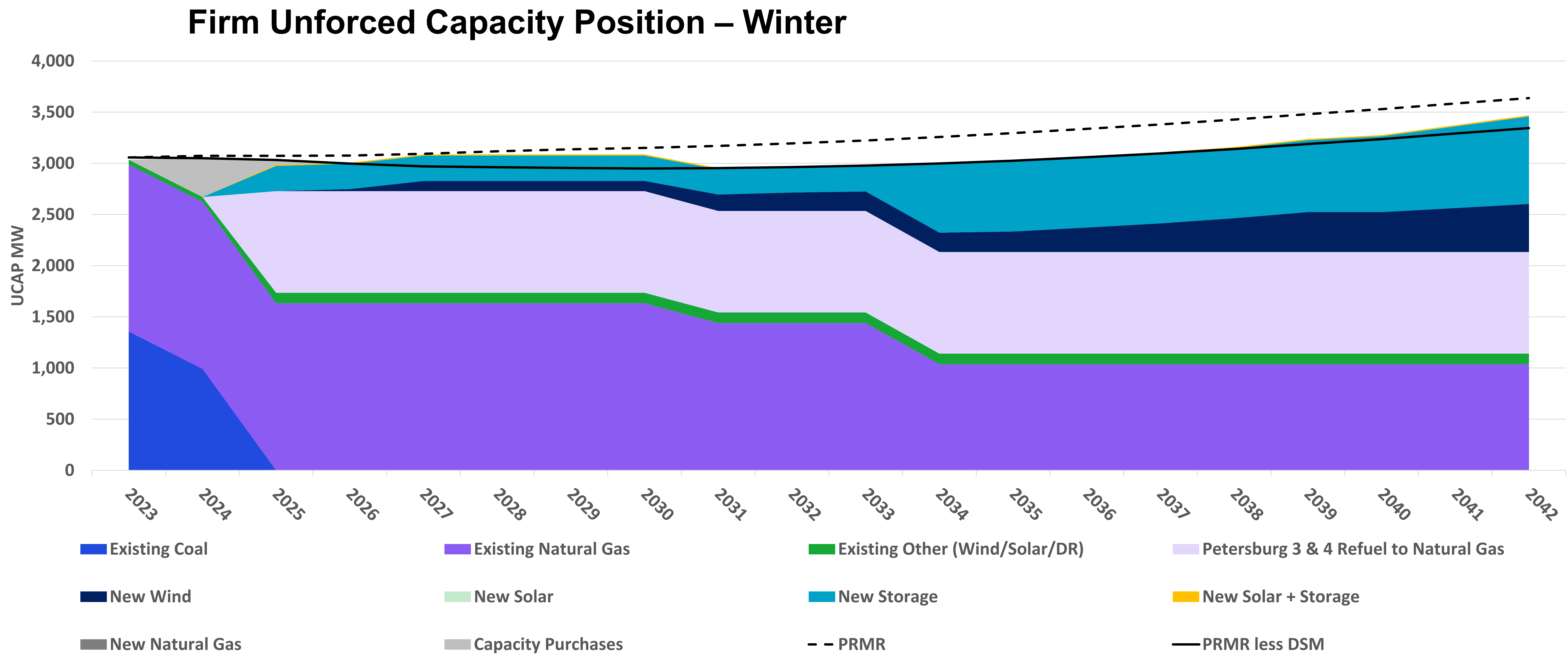
# B. Pete Refuel by 2025

| *20-Year PVRR (2023$MM, 2023-2042)* | **Scenarios** | | | |
|---|---|---|---|---|
| **Generation Strategy:** *Pete Refuel to 100% Gas (est. 2025)* | **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| | | | | **$9,546** |

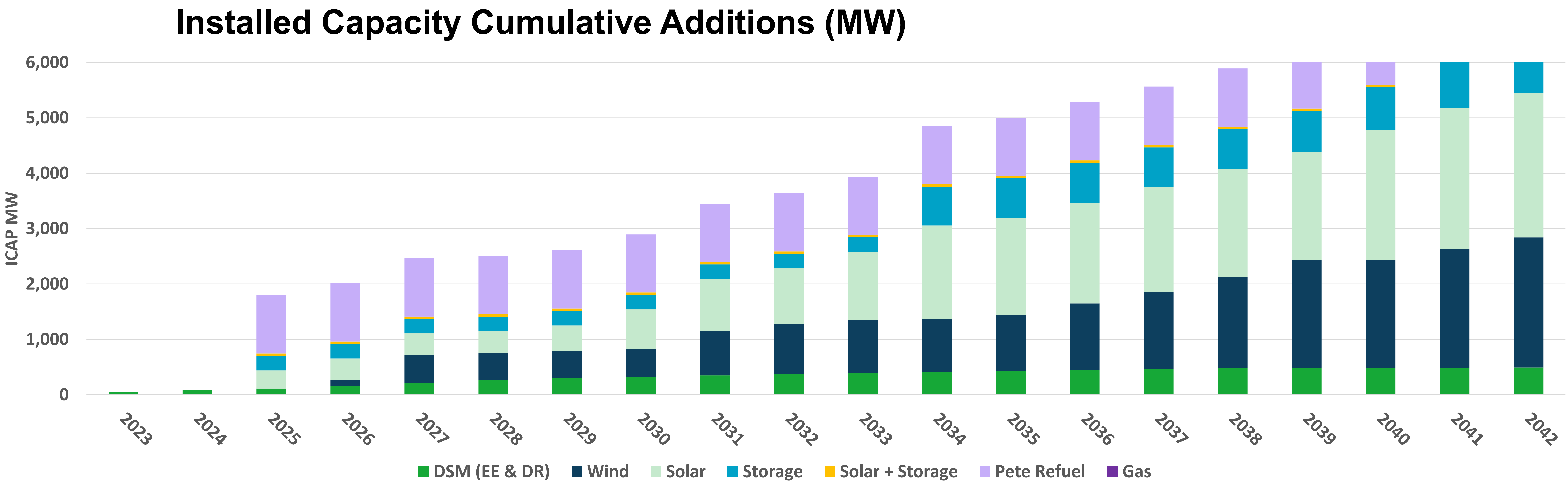
# Pete 3 & 4 Refuel in 2025: Decarbonized Economy



# Pete 3 & 4 Refuel in 2025: Decarbonized Economy



# Pete 3 & 4 Refuel in 2025: Decarbonized Economy



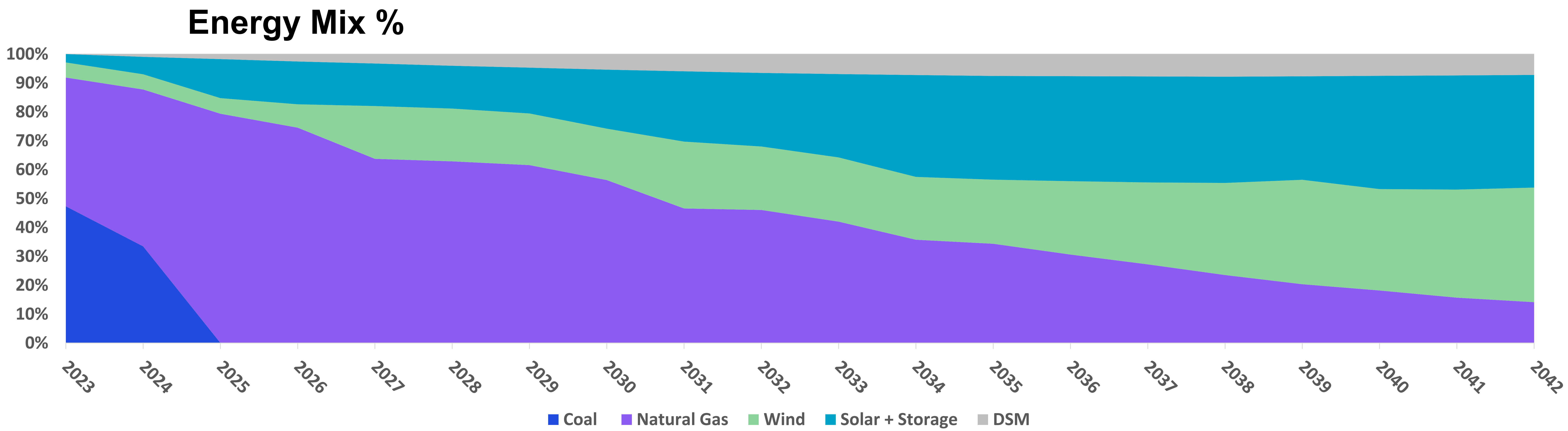

***Installed Capacity Incremental Additions (MW): 2023 - 2028***

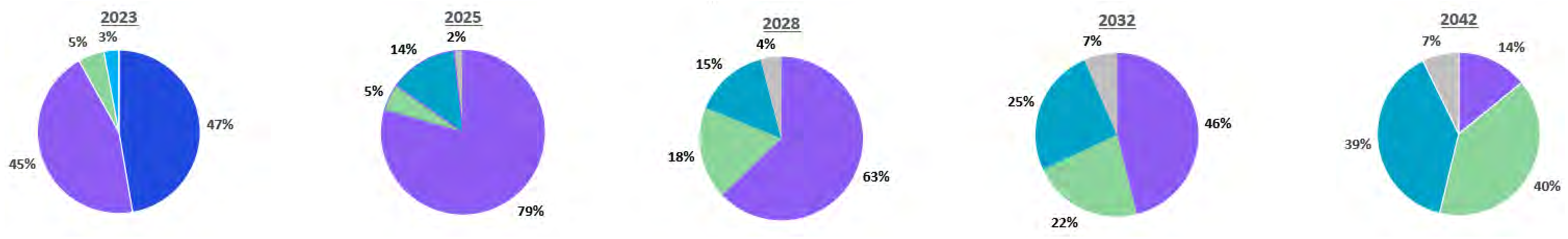
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 100 | 400 | 0 |
| Solar | 0 | 0 | 325 | 65 | 0 | 0 |
| Storage | 0 | 0 | 260 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |



AES Indiana

# Pete 3 & 4 Refuel in 2025: Decarbonized Economy




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 79% | Thermal MWh % | 63% | Thermal MWh % | 46% | Thermal MWh % | 14% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 21% | Renewable/DSM MWh % | 37% | Renewable/DSM MWh % | 54% | Renewable/DSM MWh % | 86% |


aes Indiana

# Pete 3 & 4 Refuel in 2025: Decarbonized Economy

## Portfolio Overview

### *Retirements*

Petersburg:

- Pete 3 & 4 Coal: 2025 Refuel with Nat Gas
  - **Total Refueled MW: 1,040 MW**

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 490 MW
- Wind: 2,350 MW
- Solar: 2,600 MW
- Storage: 900 MW
- Solar + Storage: 45 MW
- Thermal: 0
- Pete 3 & 4 Refueled to Nat Gas: 1,052 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | **Decarbonized Economy** |
| **No Early Retirement** | $9,917 |
| **Pete Refuel to 100% Gas (est. 2025)** | **$9,546** |
| **One Pete Unit Retires (2026)** | $9,955 |
| **Both Pete Units Retire (2026 & 2028)** | $9,923 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,690 |
| **Encompass Optimization without predefined Strategy** | $9,572 |



AES Indiana

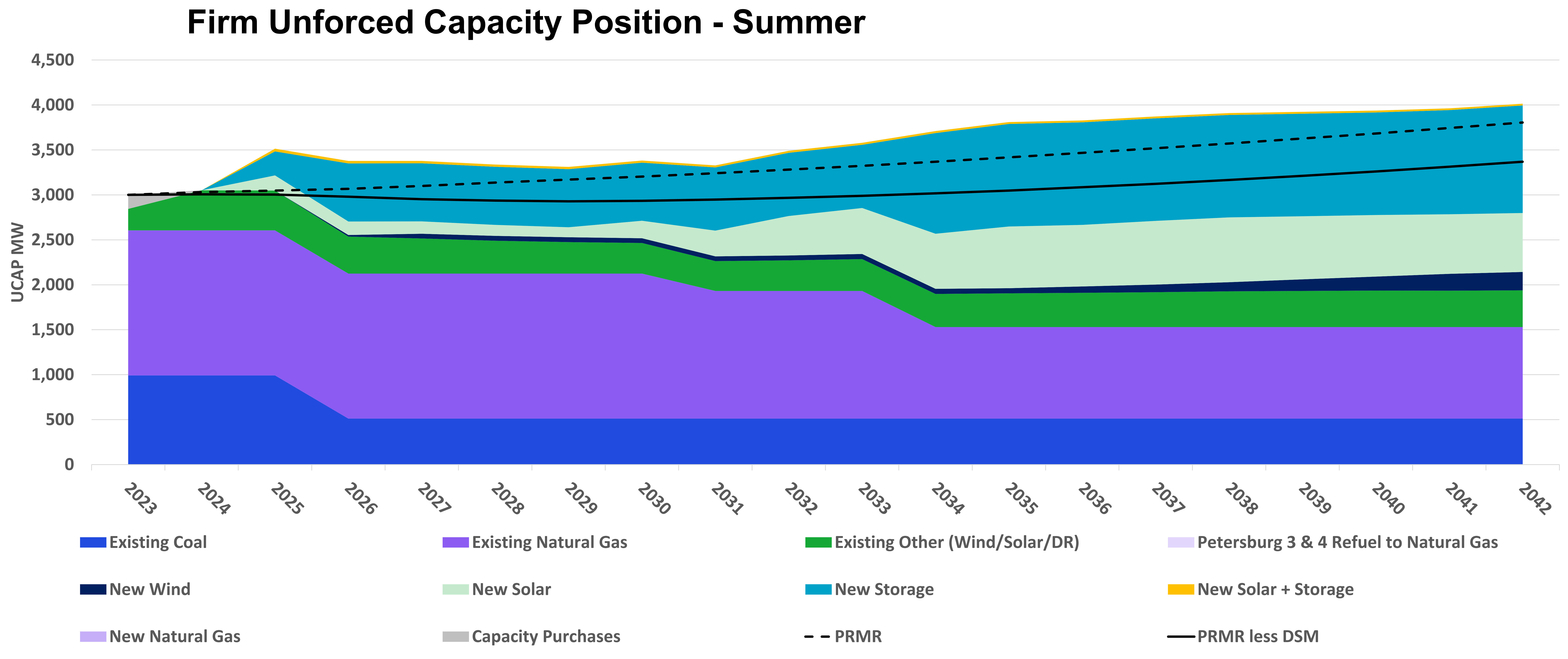
# C. One Pete Unit Retires (2026)

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

**Generation Strategy:** *One Pete Unit Retires (2026)*

| Scenarios | | | |
|---|---|---|---|
| **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| | | | **$9,955** |

# One Pete Unit Retires (2026): Decarbonized Economy

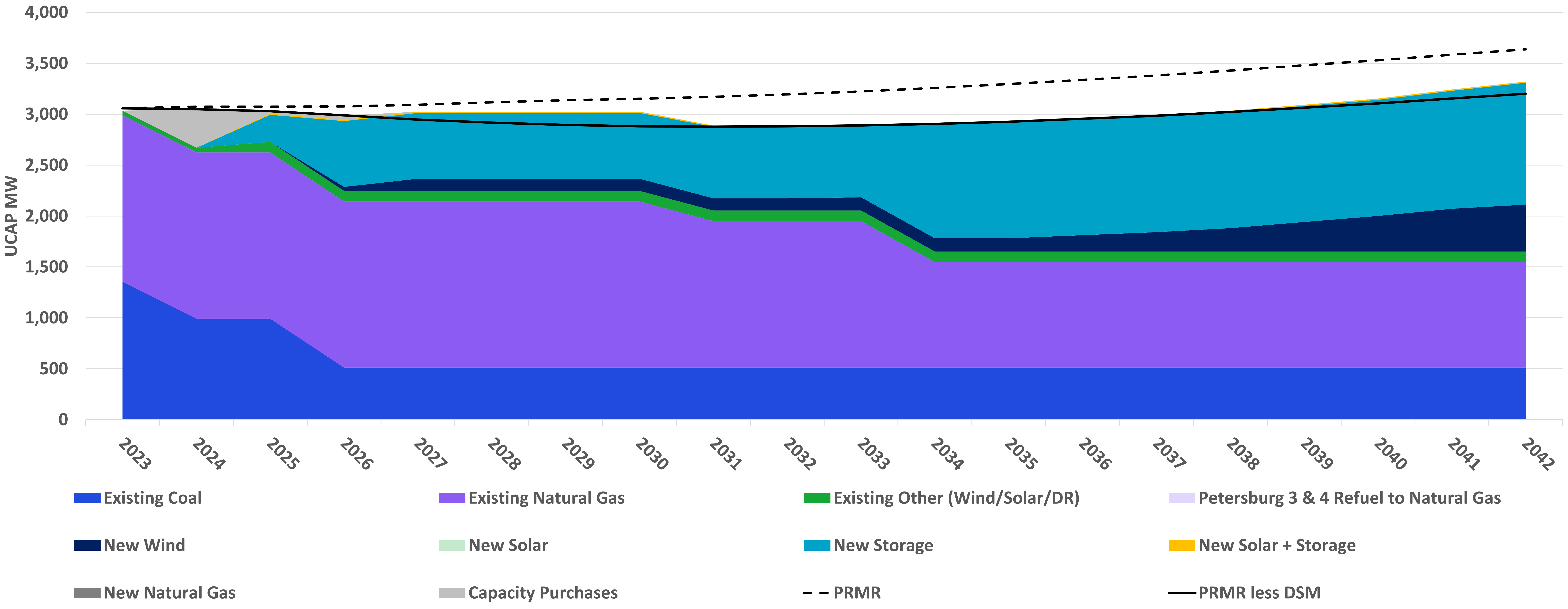





aes Indiana

# One Pete Unit Retires (2026): Decarbonized Economy

## Firm Unforced Capacity Position - Winter

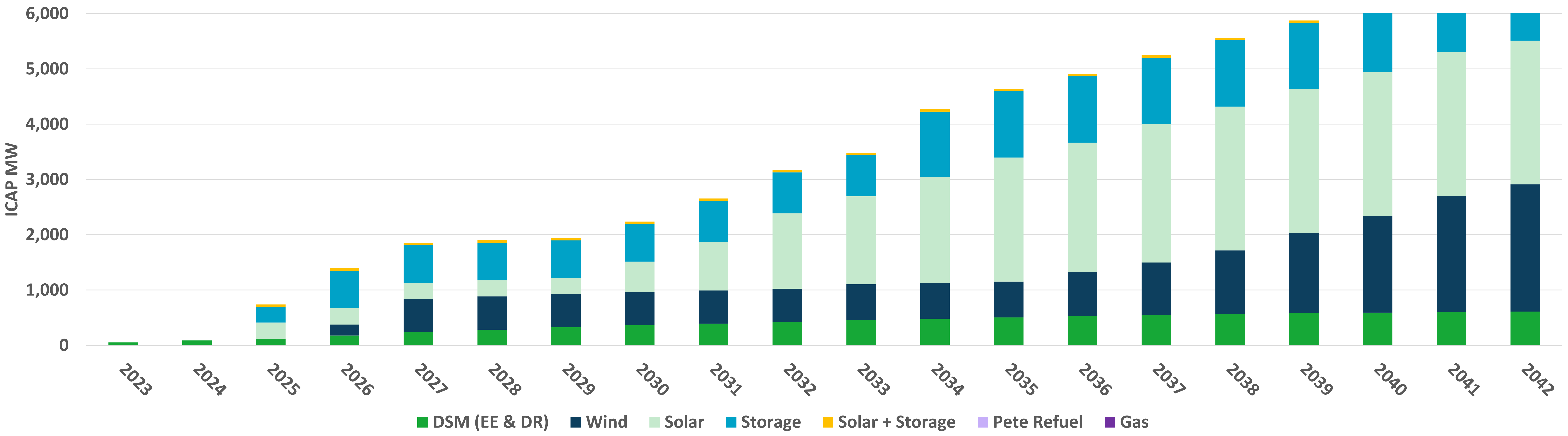





AES Indiana

# One Pete Unit Retires (2026): Decarbonized Economy

## Installed Capacity Cumulative Additions (MW)



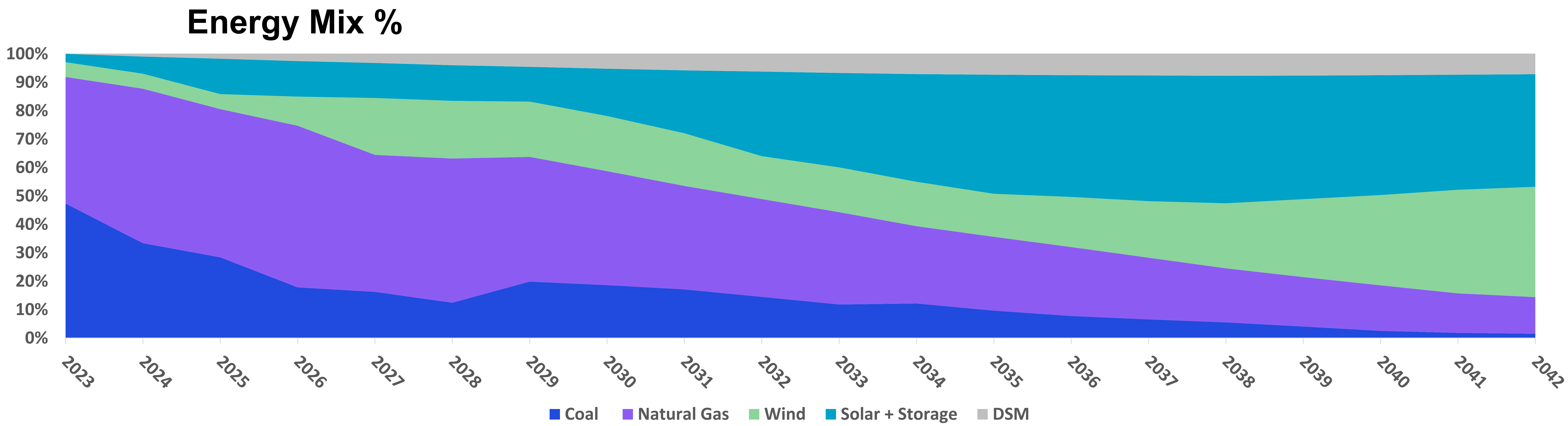

### *Installed Capacity Incremental Additions (MW): 2023 - 2028*

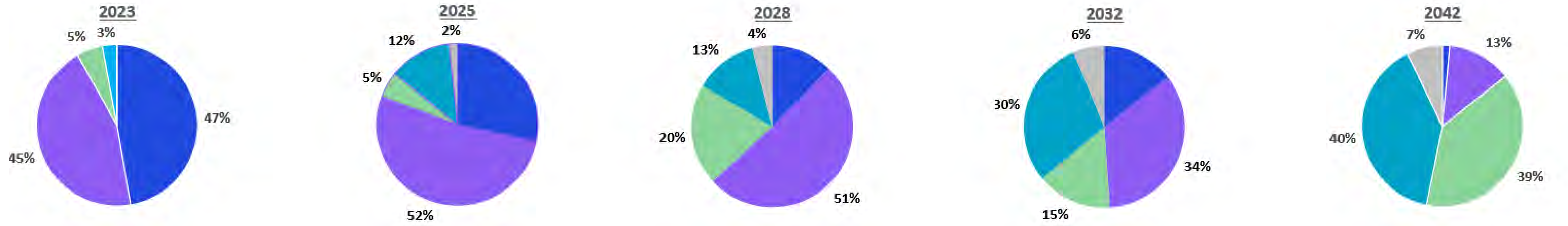
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 200 | 400 | 0 |
| Solar | 0 | 0 | 293 | 0 | 0 | 0 |
| Storage | 0 | 0 | 280 | 400 | 0 | 0 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |



aes Indiana

# One Pete Unit Retires (2026): Decarbonized Economy




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 81% | Thermal MWh % | 63% | Thermal MWh % | 49% | Thermal MWh % | 14% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 19% | Renewable/DSM MWh % | 37% | Renewable/DSM MWh % | 51% | Renewable/DSM MWh % | 86% |



aes Indiana

# One Pete Unit Retires (2026): Decarbonized Economy

## Portfolio Overview

### *Retirements*

Petersburg:
- Pete 3 Coal: 2026
  - **Total Coal Retired MW: 520 MW**

Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 610 MW
- Wind: 2,300 MW
- Solar: 2,600 MW
- Storage: 1,260 MW
- Solar + Storage: 45 MW
- Thermal: 0 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | Decarbonized Economy |
| No Early Retirement | $9,917 |
| Pete Refuel to 100% Gas (est. 2025) | $9,546 |
| One Pete Unit Retires (2026) | **$9,955** |
| Both Pete Units Retire (2026 & 2028) | $9,923 |
| "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | $9,690 |
| Encompass Optimization without predefined Strategy | $9,572 |

# D. Both Pete Units Retire (2026 & 2028)

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

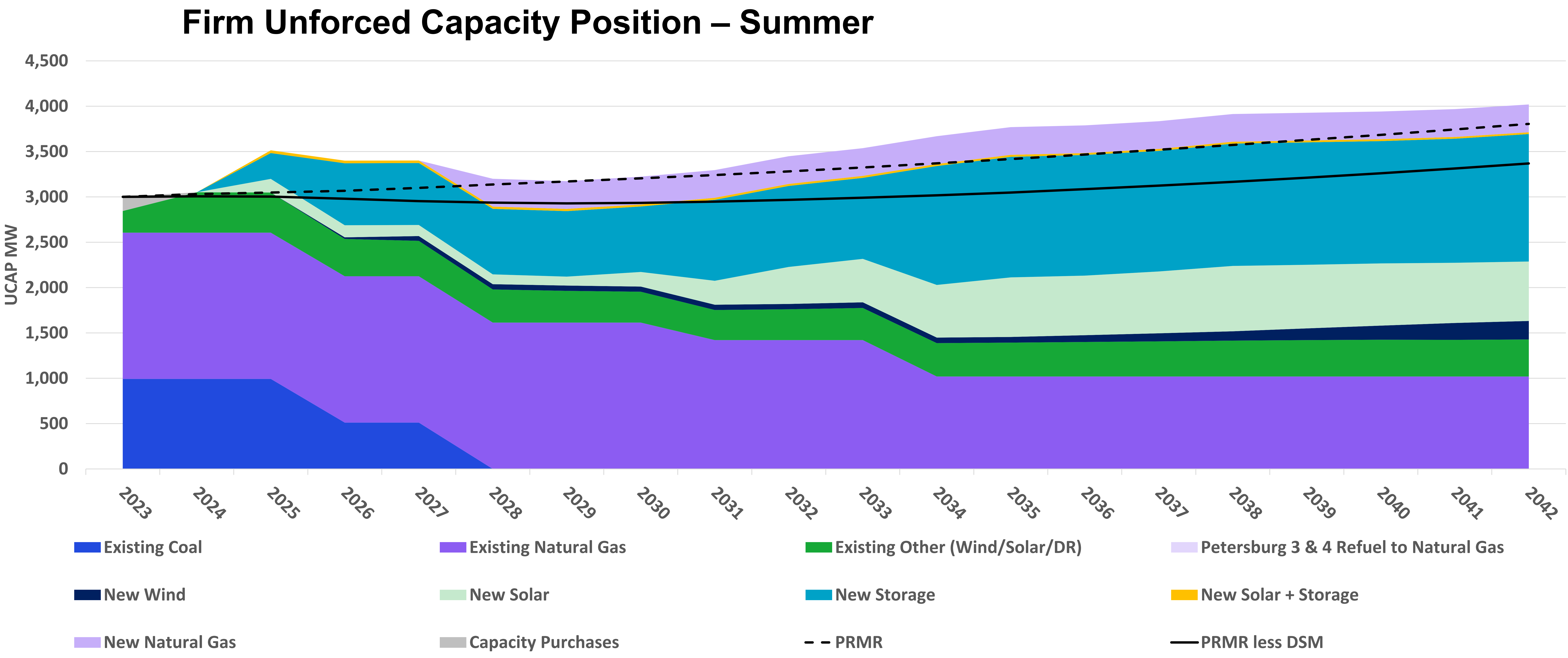
**Generation Strategy:** *Both Pete Units Retire (2026 & 2028)*

| Scenarios | | | |
|---|---|---|---|
| No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| | | | $9,923 |


aes Indiana

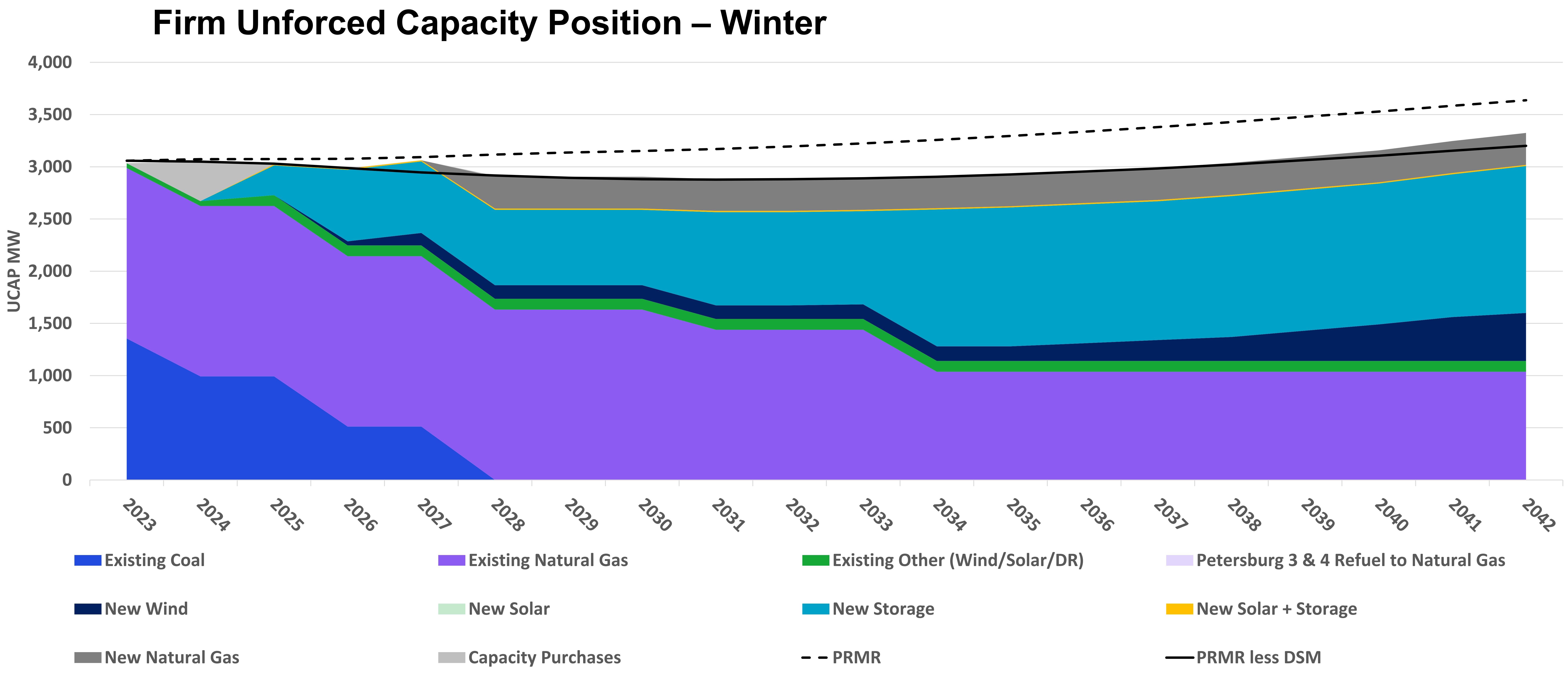
# Both Pete Units Retire: Decarbonized Economy

***2026 & 2028***



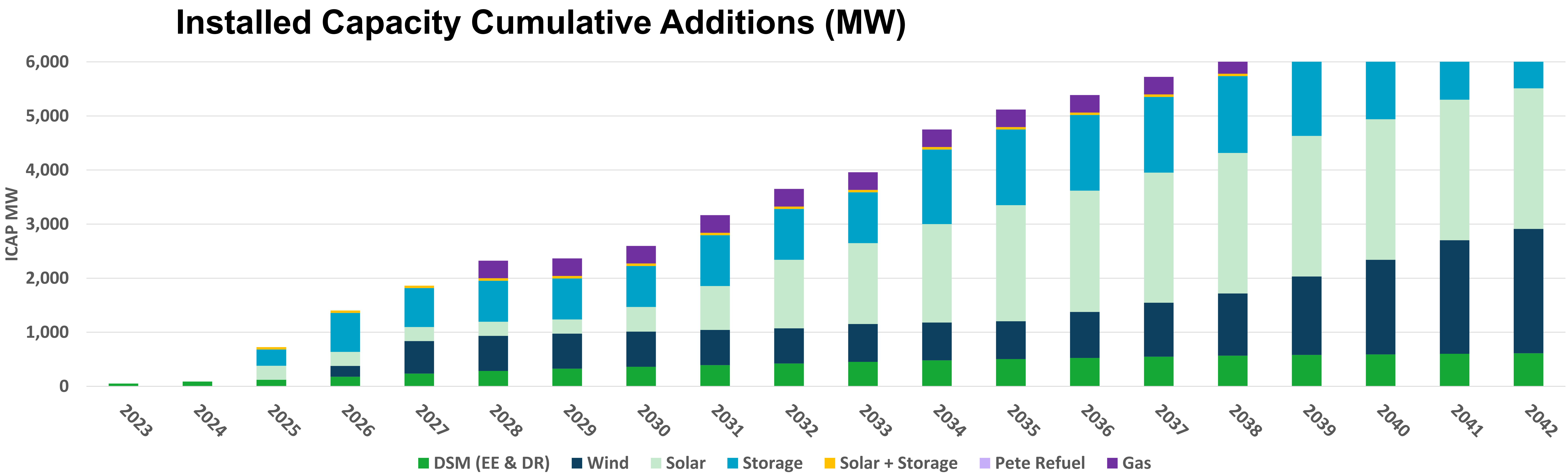
# Both Pete Units Retire: Decarbonized Economy

*2026 & 2028*



# Both Pete Units Retire: Decarbonized Economy

*2026 & 2028*



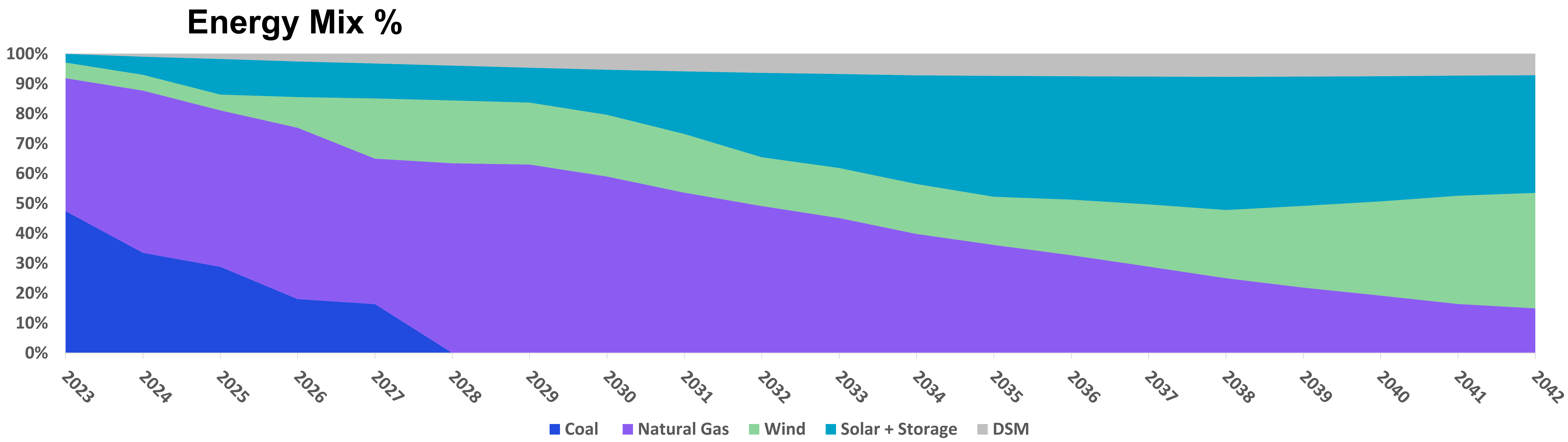

## *Installed Capacity Incremental Additions (MW): 2023 – 2028*

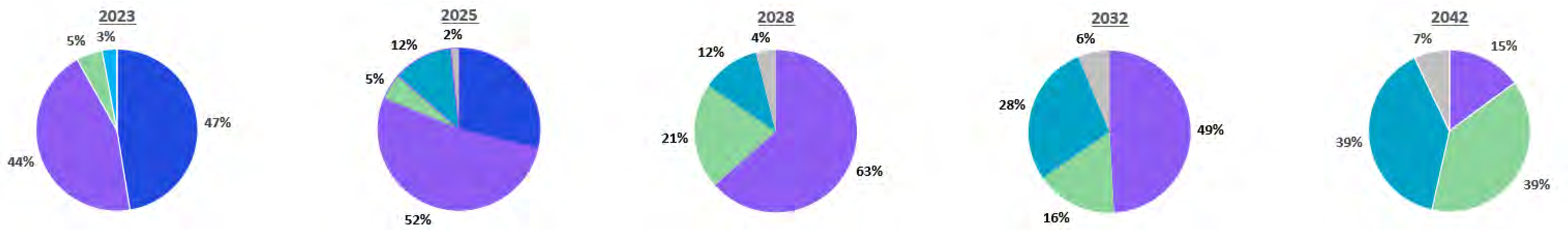
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 200 | 400 | 50 |
| Solar | 0 | 0 | 260 | 0 | 0 | 0 |
| Storage | 0 | 0 | 300 | 420 | 0 | 40 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 325 |


aes Indiana

# Both Pete Units Retire: Decarbonized Economy

***2026 & 2028***




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 81% | Thermal MWh % | 63% | Thermal MWh % | 49% | Thermal MWh % | 15% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 19% | Renewable/DSM MWh % | 37% | Renewable/DSM MWh % | 51% | Renewable/DSM MWh % | 85% |

# Both Pete Units Retire: Decarbonized Economy

*2026 & 2028*

## Portfolio Overview

### *Retirements*

- Petersburg:
- Pete 3 Coal: 2026
- Pete 4 Coal: 2028
  - **Total Coal Retired MW: 1,040 MW**

- Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 610 MW
- Wind: 2,300 MW
- Solar: 2,600 MW
- Storage: 1,480 MW
- Solar + Storage: 45 MW
- Thermal: 325 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | **Decarbonized Economy** |
| **No Early Retirement** | $9,917 |
| **Pete Refuel to 100% Gas (est. 2025)** | $9,546 |
| **One Pete Unit Retires (2026)** | $9,955 |
| **Both Pete Units Retire (2026 & 2028)** | **$9,923** |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,690 |
| **Encompass Optimization without predefined Strategy** | $9,572 |



aes Indiana

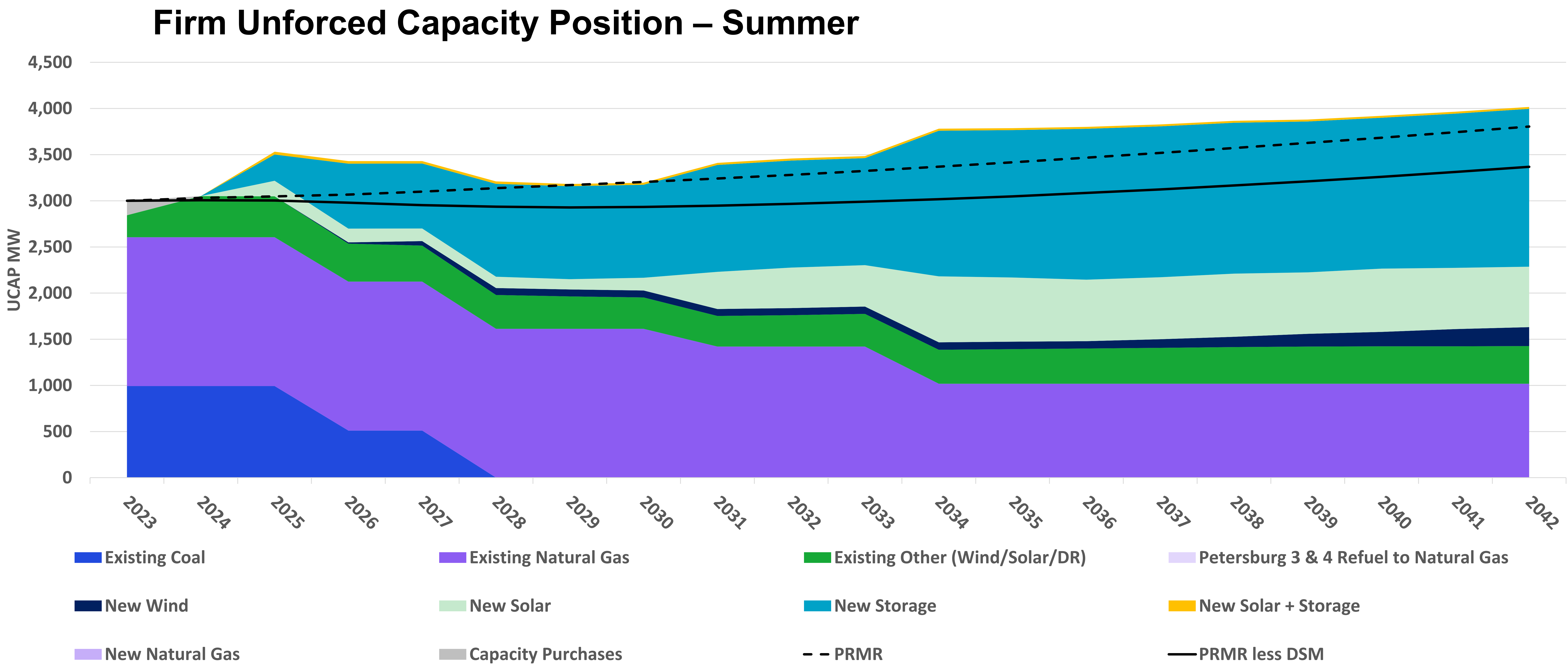
# E. Clean Energy Strategy

*Retire & Replace Pete with Clean Energy*

| *20-Year PVRR (2023$MM, 2023-2042)* | Scenarios | | | |
|---|---|---|---|---|
| | No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| **Generation Strategy:** *"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)* | | | | **$9,690** |

# Clean Energy Strategy: Decarbonized Economy

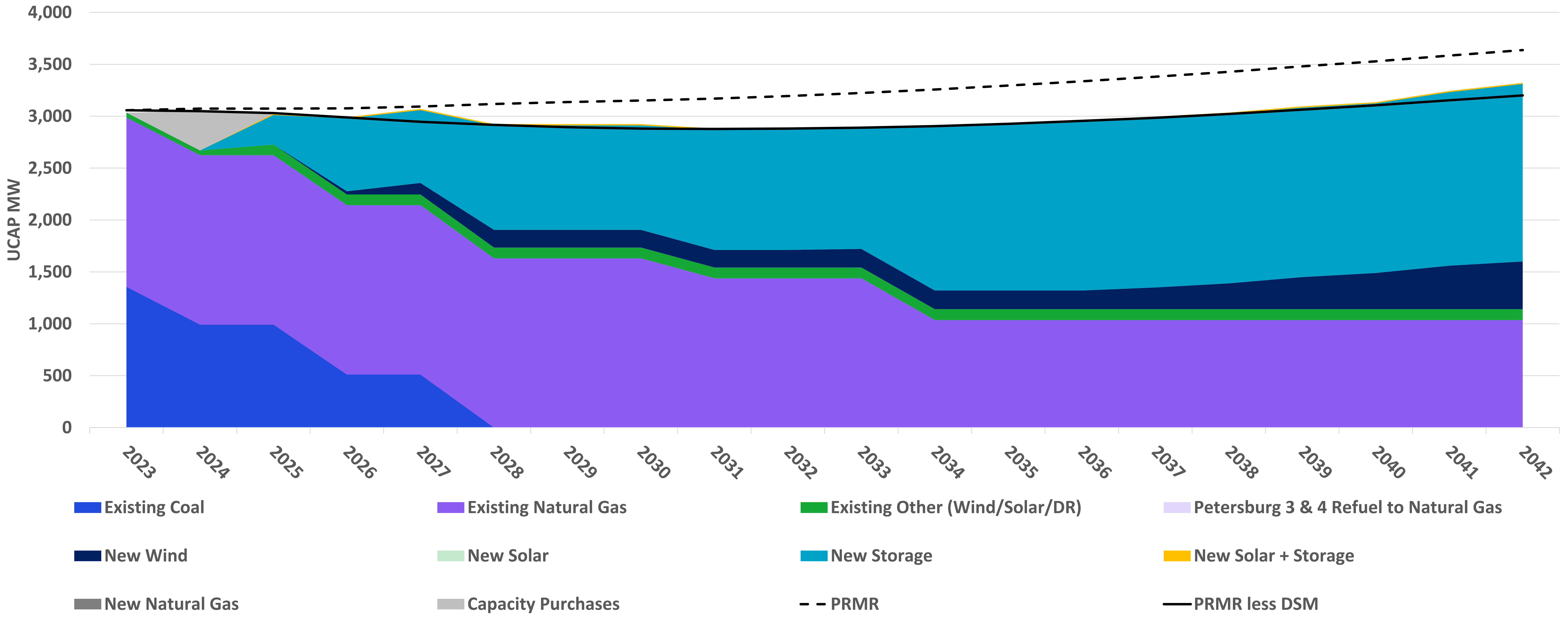
***Retire & Replace Pete with Clean Energy***



# Clean Energy Strategy: Decarbonized Economy

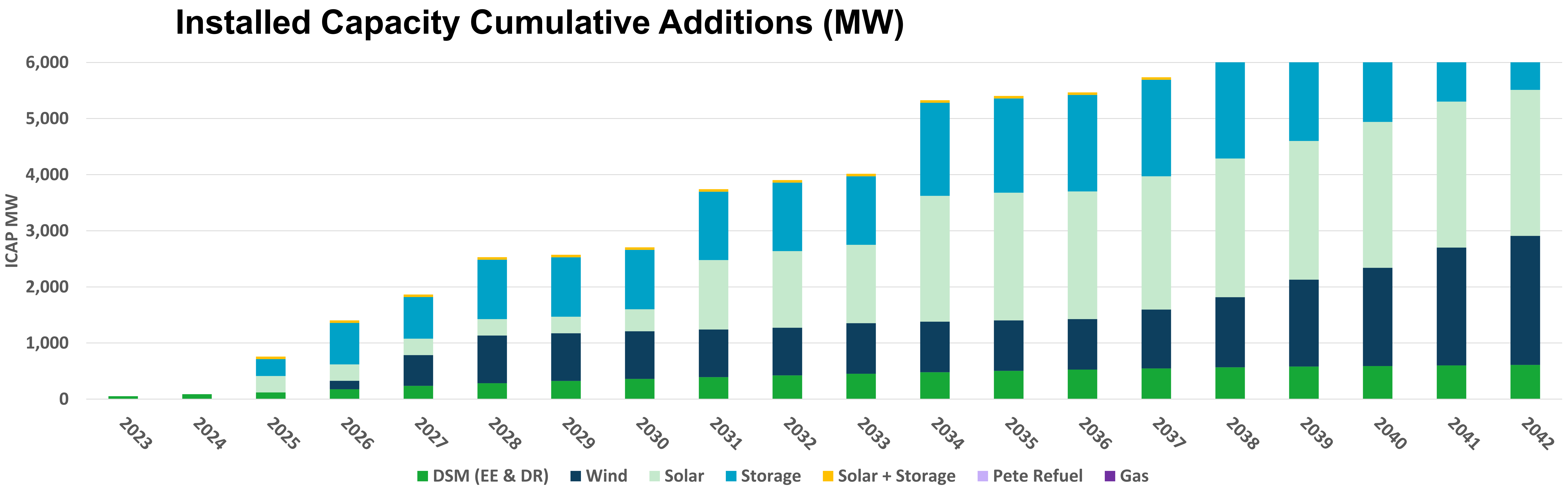
***Retire & Replace Pete with Clean Energy***

## Firm Unforced Capacity Position – Winter



# Clean Energy Strategy: Decarbonized Economy

*Retire & Replace Pete with Clean Energy*



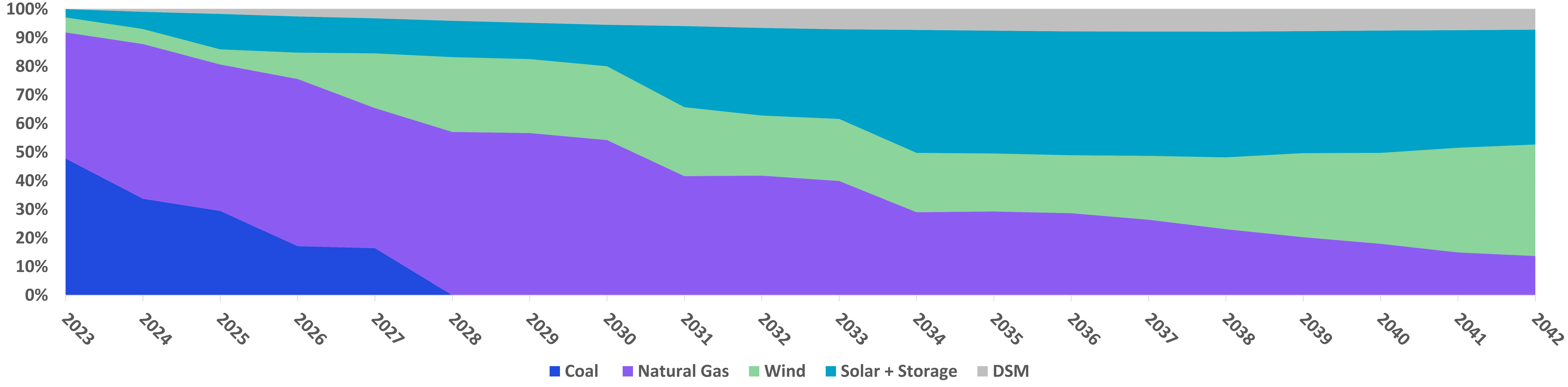

### *Installed Capacity Incremental Additions (MW): 2023 – 2028*

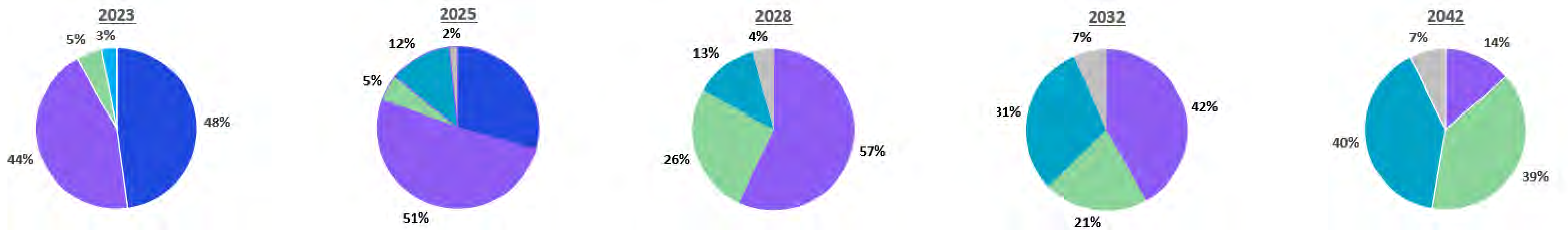
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 150 | 400 | 300 |
| Solar | 0 | 0 | 293 | 0 | 0 | 0 |
| Storage | 0 | 0 | 300 | 440 | 0 | 320 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |

# Clean Energy Strategy: Decarbonized Economy

***Retire & Replace Pete with Clean Energy***

## Energy Mix %




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 81% | Thermal MWh % | 57% | Thermal MWh % | 42% | Thermal MWh % | 14% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 19% | Renewable/DSM MWh % | 43% | Renewable/DSM MWh % | 58% | Renewable/DSM MWh % | 86% |



aes Indiana

# Clean Energy Strategy: Decarbonized Economy

*Retire & Replace Pete with Clean Energy*

## Portfolio Overview

### *Retirements*

Petersburg:

- Pete 3 Coal: 2026
- Pete 4 Coal: 2028
  - **Total Coal Retired MW: 1,040 MW**

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Retired Nat Gas MW: 618 MW**

### *Replacements by 2042*

- DSM: 610 MW
- Wind: 2,300 MW
- Solar: 2,600 MW
- Storage: 1,800 MW
- Solar + Storage: 45 MW
- Thermal: 0 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | **Decarbonized Economy** |
| **No Early Retirement** | $9,917 |
| **Pete Refuel to 100% Gas (est. 2025)** | $9,546 |
| **One Pete Unit Retires (2026)** | $9,955 |
| **Both Pete Units Retire (2026 & 2028)** | $9,923 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | **$9,690** |
| **Encompass Optimization without predefined Strategy** | $9,572 |



aes Indiana

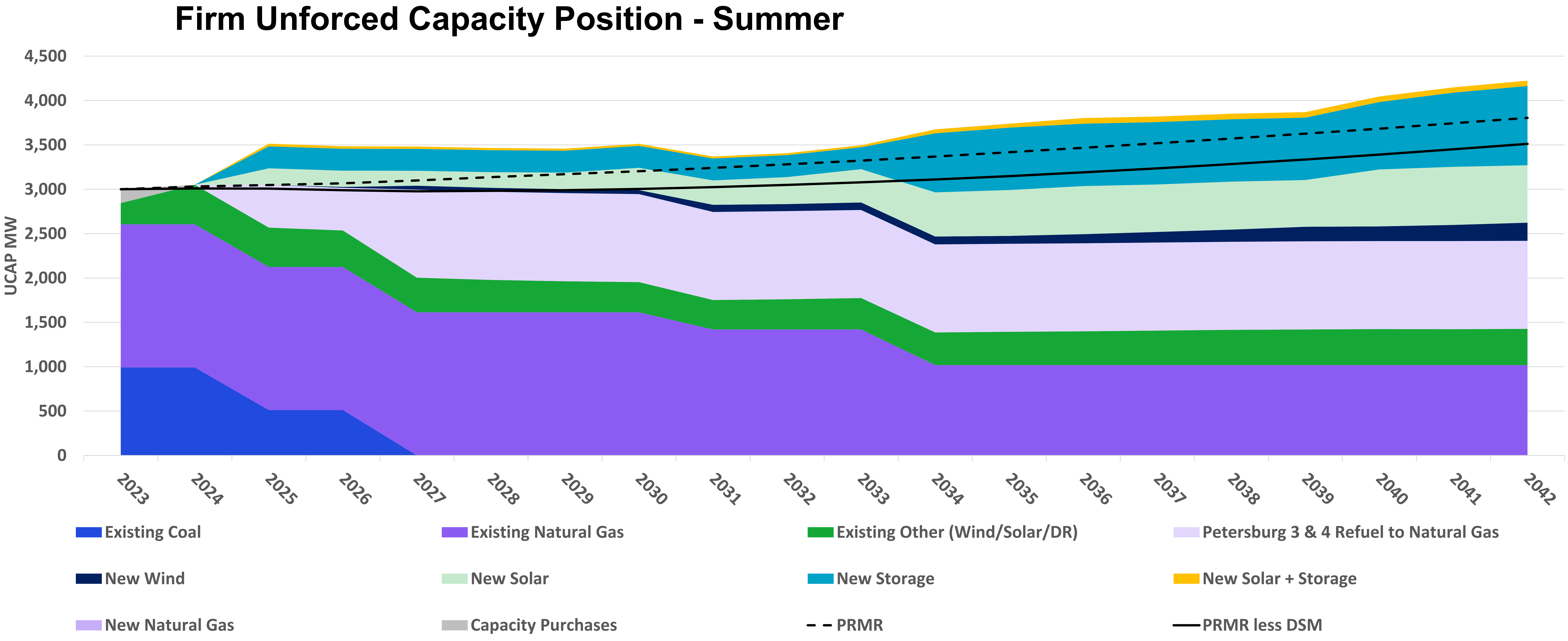
# F. Encompass Optimization

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

| ***20-Year PVRR (2023$MM, 2023-2042)*** | **Scenarios** | | | |
|---|---|---|---|---|
| **Generation Strategy:** | **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| ***Encompass Optimization without predefined Strategy – Selects Pete 3 Refuel in 2025 & Pete 4 Refuel in 2027*** | | | | **$9,572** |

# Encompass Optimization: Decarbonized Economy

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

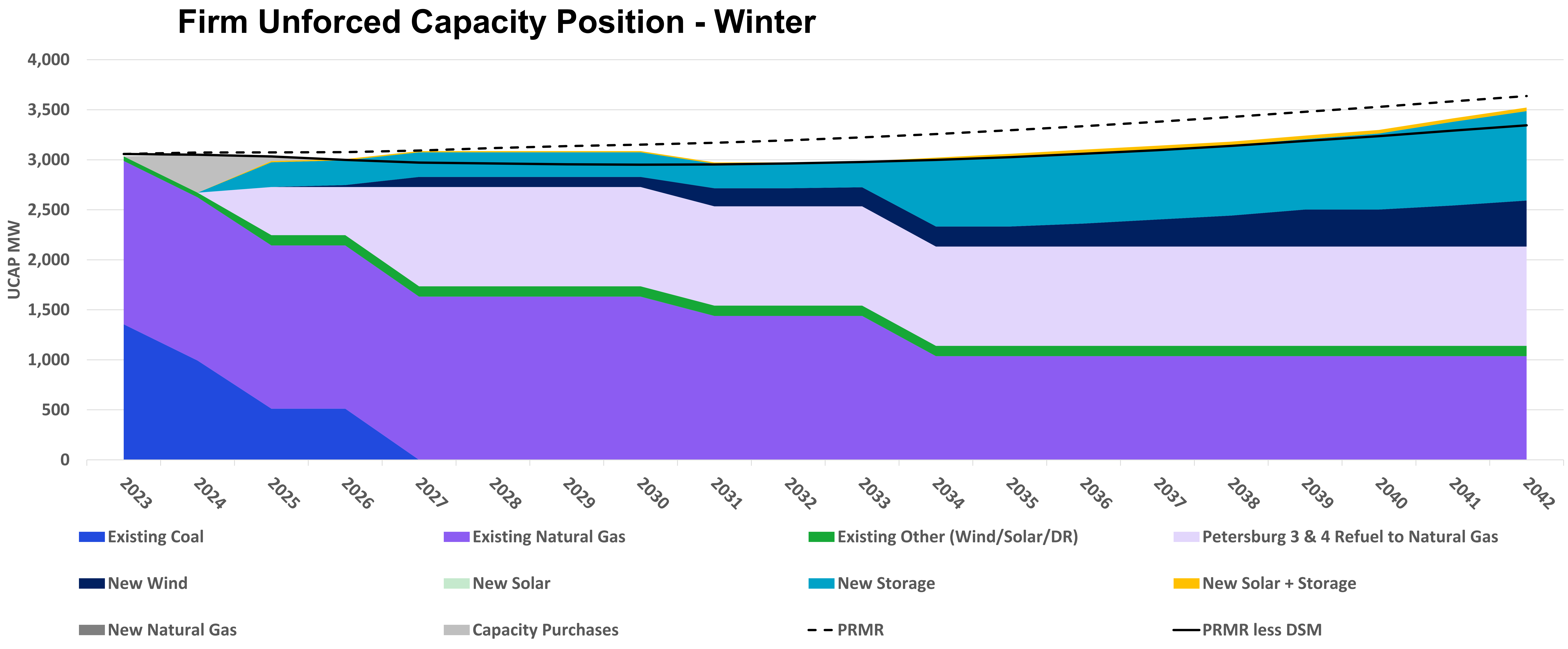




AES Indiana

# Encompass Optimization: Decarbonized Economy

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

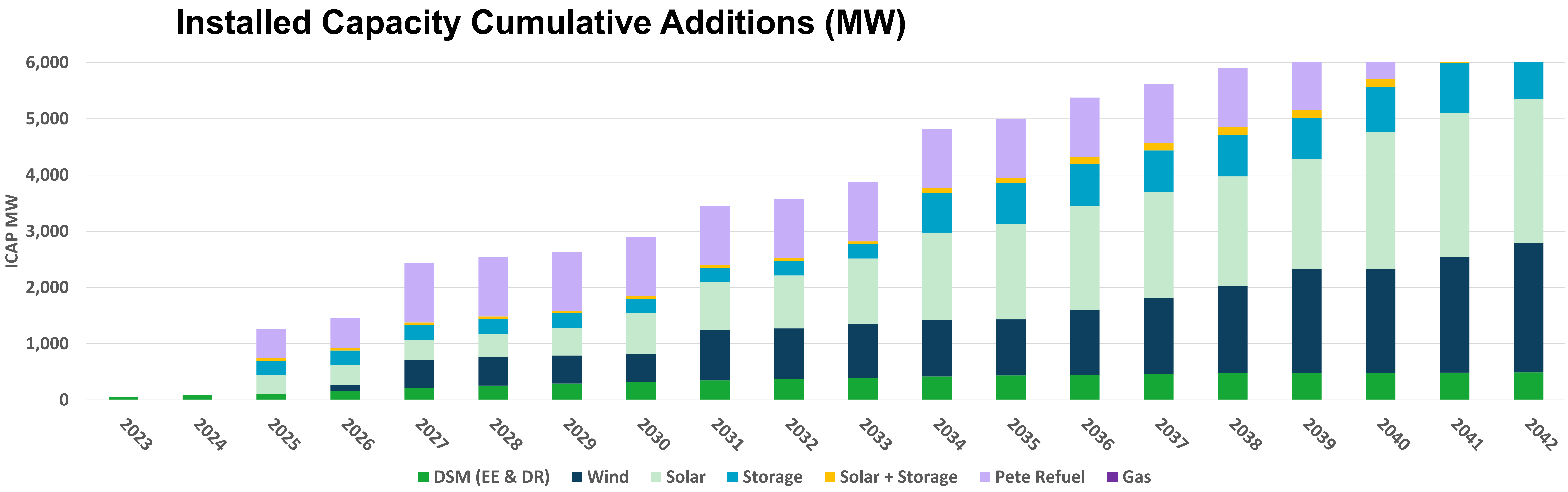





aes Indiana

# Encompass Optimization: Decarbonized Economy

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




***Installed Capacity Incremental Additions (MW): 2023 - 2028***

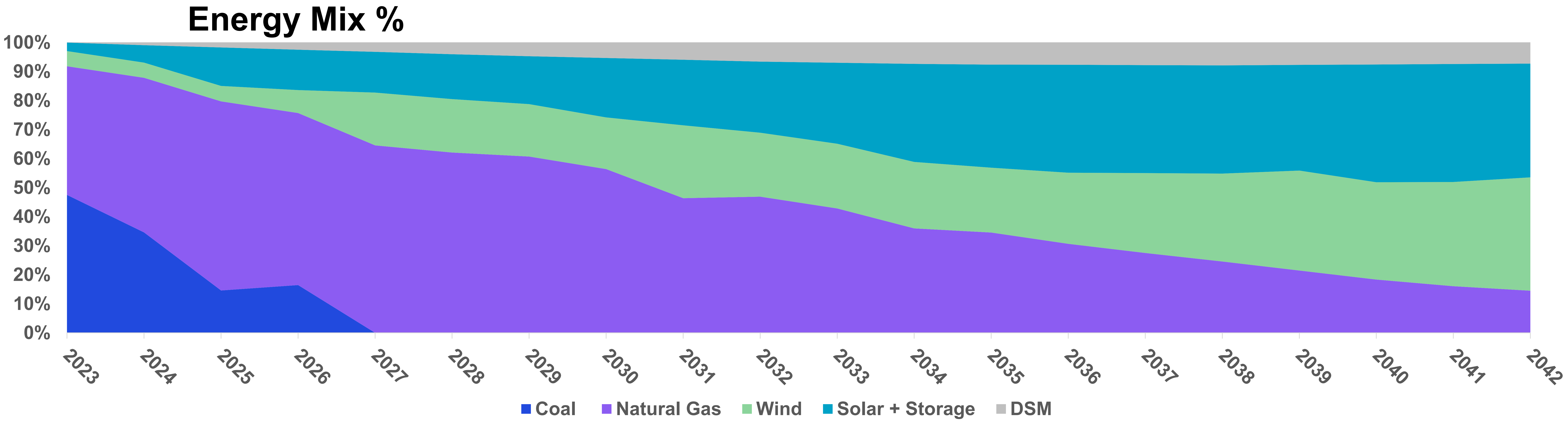
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 100 | 400 | 0 |
| Solar | 0 | 0 | 325 | 33 | 0 | 65 |
| Storage | 0 | 0 | 260 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |

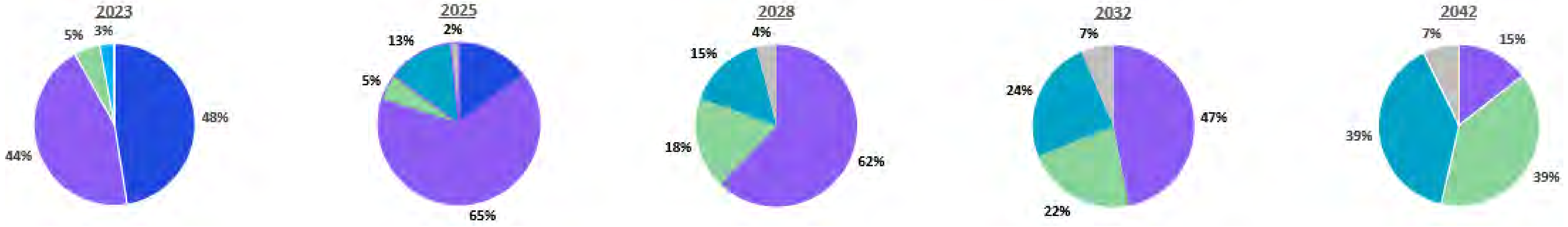


aes Indiana

# Encompass Optimization: Decarbonized Economy

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




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 80% | Thermal MWh % | 62% | Thermal MWh % | 47% | Thermal MWh % | 15% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 20% | Renewable/DSM MWh % | 38% | Renewable/DSM MWh % | 53% | Renewable/DSM MWh % | 85% |



aes Indiana

# Encompass Optimization: Decarbonized Economy

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

## Portfolio Overview

### *Retirements*

Petersburg:
- Pete 3 Coal: 2025
- Pete 4 Coal: 2027
  - **Total Refueled MW: 1,040 MW**

Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 490 MW
- Wind: 2,300 MW
- Solar: 2,568 MW
- Storage: 940 MW
- Solar + Storage: 135 MW
- Thermal: 0
- Pete 3 & 4 Refueled to Nat Gas: 1,052 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | **Decarbonized Economy** |
| **No Early Retirement** | $9,917 |
| **Pete Refuel to 100% Gas (est. 2025)** | $9,546 |
| **One Pete Unit Retires (2026)** | $9,955 |
| **Both Pete Units Retire (2026 & 2028)** | $9,923 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $9,690 |
| **Encompass Optimization without predefined Strategy** | **$9,572** |



AES Indiana

# Portfolio Matrix

| *20-Year PVRR (2023$MM, 2023-2042)* | | Scenarios | | | |
|---|---|---|---|---|---|
| | | **No Environmental Action** | **Current Trends (Reference Case)** | **Aggressive Environmental** | **Decarbonized Economy** |
| **Generation Strategies** | **No Early Retirement** | $7,111 | $9,572 | $11,349 | $9,917 |
| | **Pete Refuel to 100% Gas (est. 2025)** | $6,621 | $9,330 | $11,181 | $9,546 |
| | **One Pete Unit Retires (2026)** | $7,462 | $9,773 | $11,470 | $9,955 |
| | **Both Pete Units Retire (2026 & 2028)** | $7,425 | $9,618 | $11,145 | $9,923 |
| | **"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 | Refuels Petersburg Unit 3 in 2025 & Refuels Petersburg Unit 4 in 2027 |


aes Indiana

# Aggressive Environmental

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

| | | Scenarios |
|---|---|---|
| | | **Aggressive Environmental** |
| **Generation Strategies** | **No Early Retirement** | **$11,349** |
| | **Pete Refuel to 100% Gas (est. 2025)** | **$11,181** |
| | **One Pete Unit Retires (2026)** | **$11,470** |
| | **Both Pete Units Retire (2026 & 2028)** | **$11,145** |
| | **“Clean Energy Strategy” Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | **$11,184** |
| | **Encompass Optimization without predefined Strategy – Selects Pete 4 Refuel in 2027** | **$10,994** |



aes Indiana

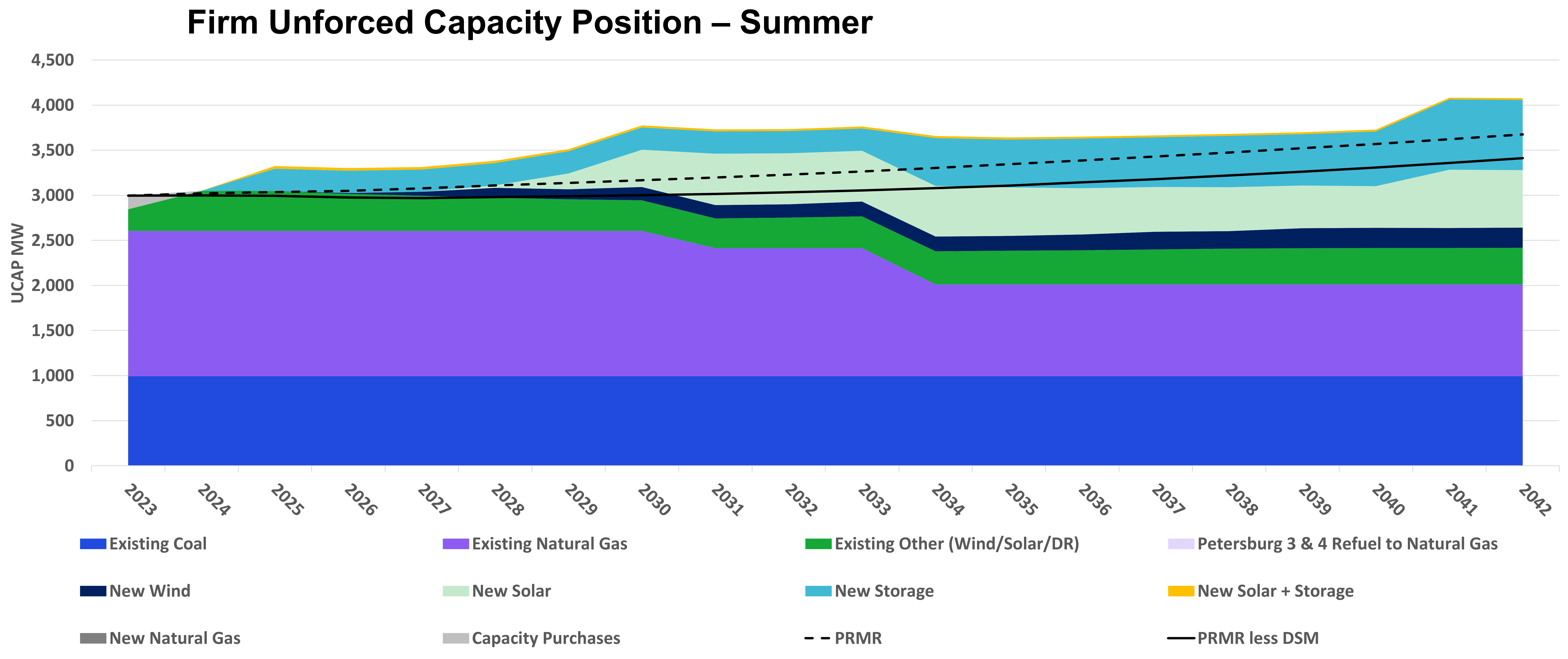
# A. No Early Retirement

| Generation Strategy: *No Early Retirement* | Scenarios | | | |
|---|---|---|---|---|
| | No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| | | | $11,349 | |



aes Indiana

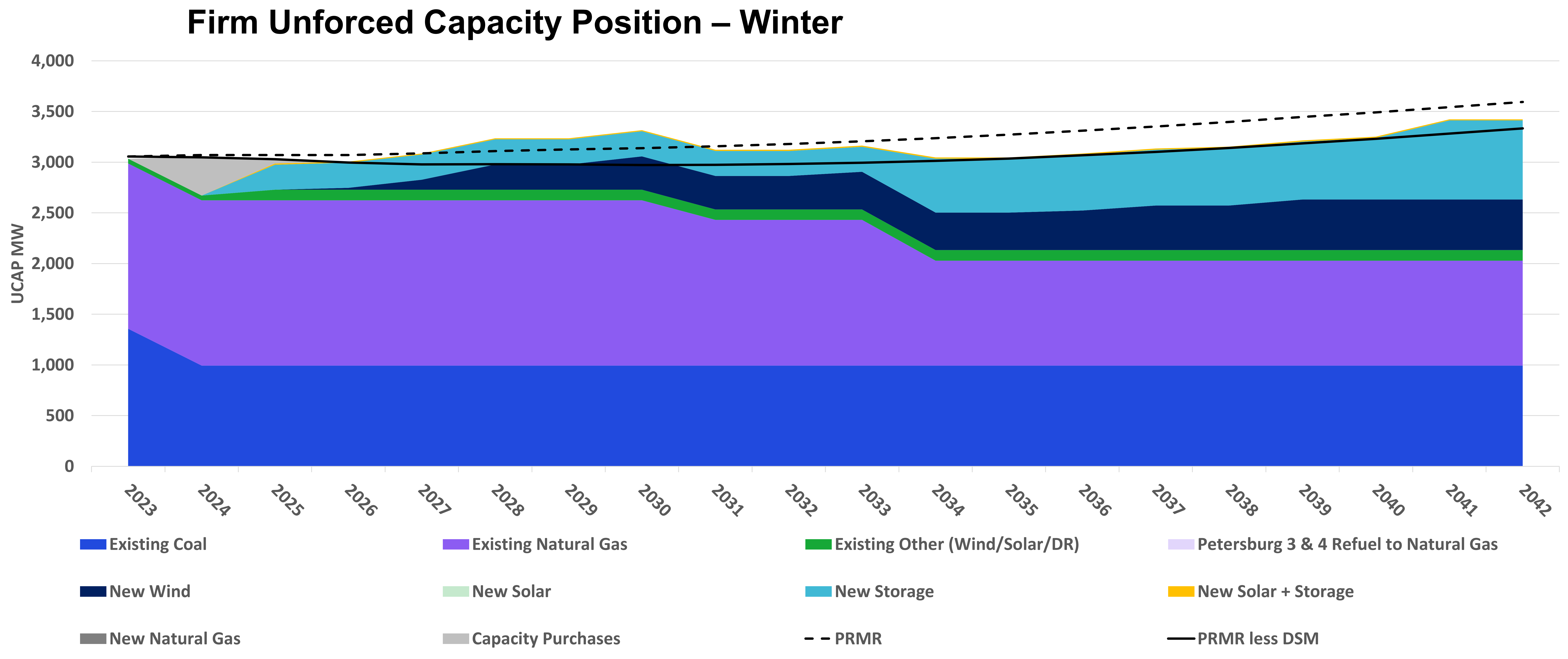
# No Early Retirement: Aggressive Environmental



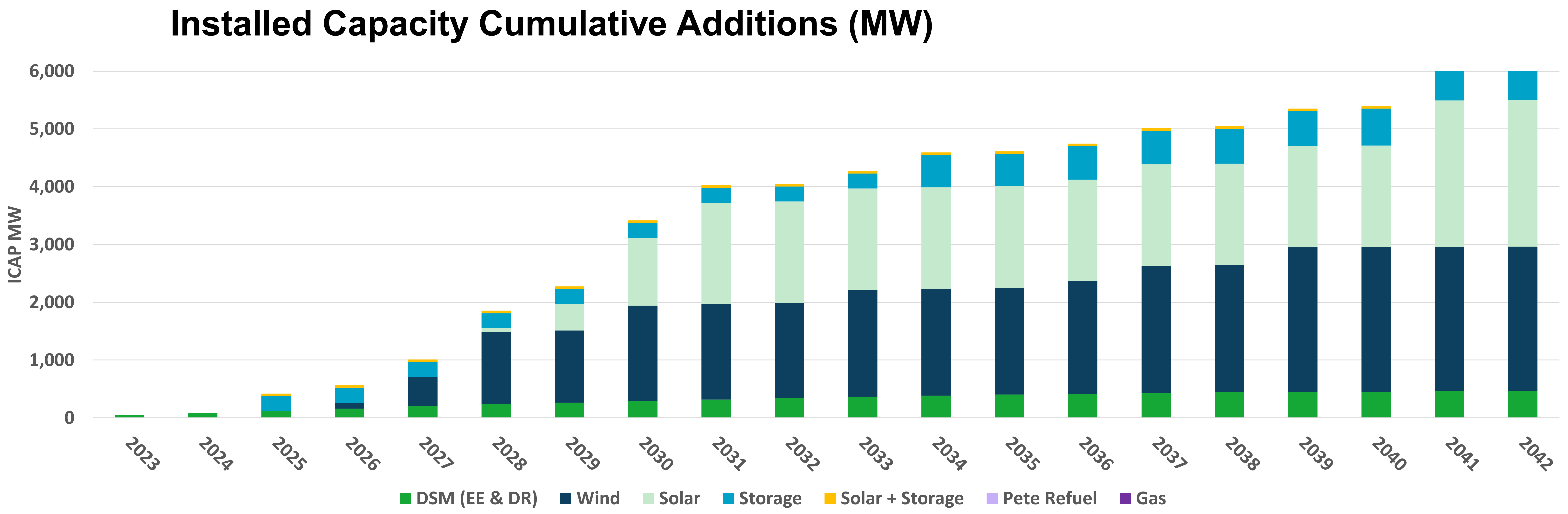



aes Indiana

# No Early Retirement: Aggressive Environmental



# **No Early Retirement:** Aggressive Environmental



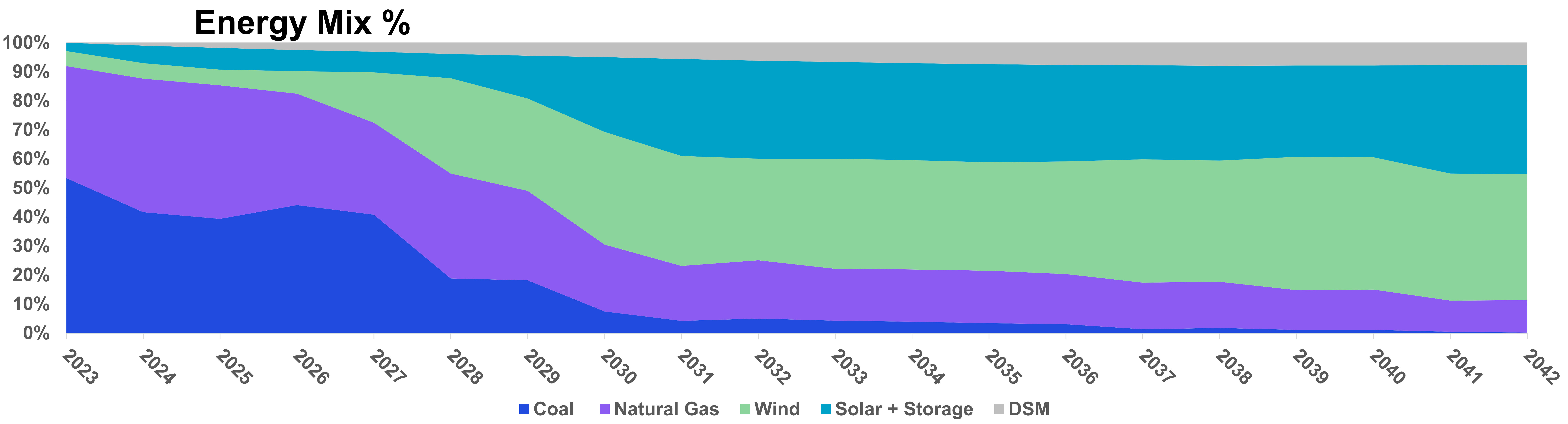

***Installed Capacity Incremental Additions (MW): 2023 - 2028***

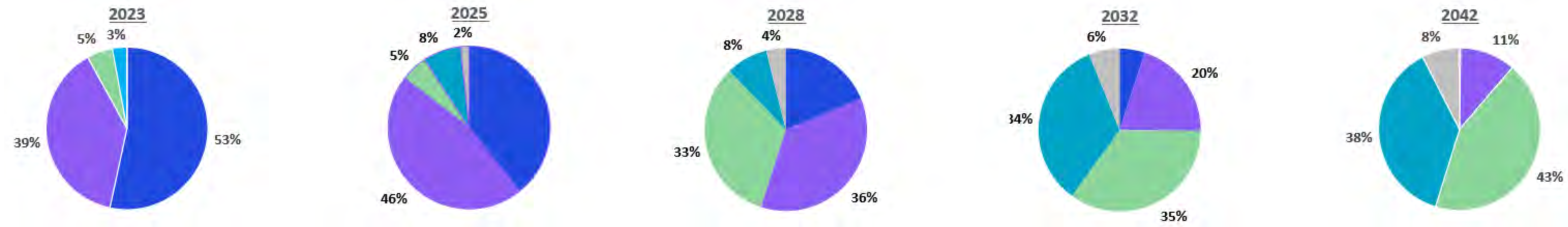
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 100 | 400 | 750 |
| Solar | 0 | 0 | 0 | 0 | 0 | 65 |
| Storage | 0 | 0 | 260 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |



aes Indiana

# No Early Retirement: Aggressive Environmental




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 85% | Thermal MWh % | 55% | Thermal MWh % | 25% | Thermal MWh % | 11% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 15% | Renewable/DSM MWh % | 45% | Renewable/DSM MWh % | 75% | Renewable/DSM MWh % | 89% |

# **No Early Retirement:** Aggressive Environmental

**Portfolio Overview**

***Retirements***

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

***Replacement Additions by 2042***

- DSM: 462 MW
- Wind: 2,500 MW
- Solar: 2,535 MW
- Storage: 820 MW
- Solar + Storage: 45 MW
- Thermal: 0 MW

***Current Trends PVRR Summary***

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

| | Scenarios |
|---|---|
| | Aggressive Environmental |
| No Early Retirement | **$11,349** |
| Pete Refuel to 100% Gas (est. 2025) | $11,181 |
| One Pete Unit Retires (2026) | $11,470 |
| Both Pete Units Retire (2026 & 2028) | $11,145 |
| "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | $11,184 |
| Encompass Optimization without predefined Strategy | $10,994 |

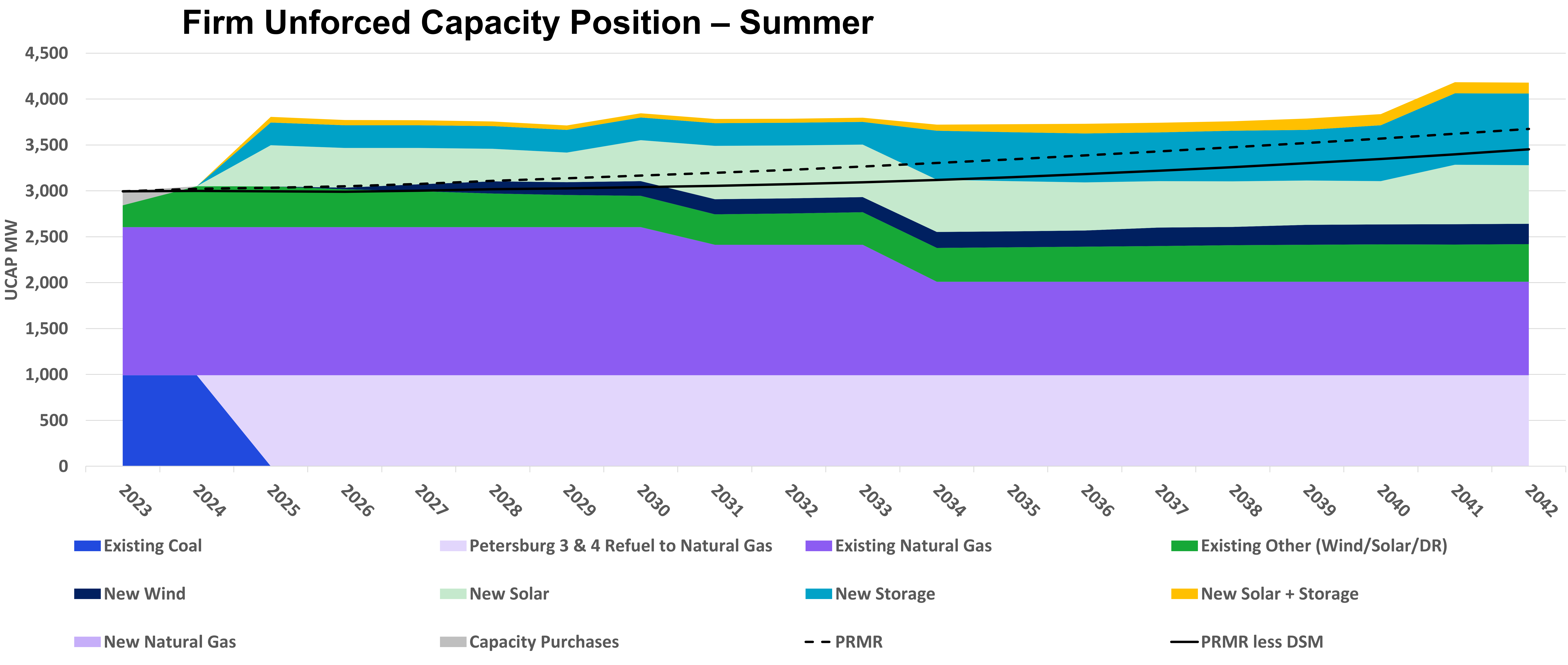


aes Indiana

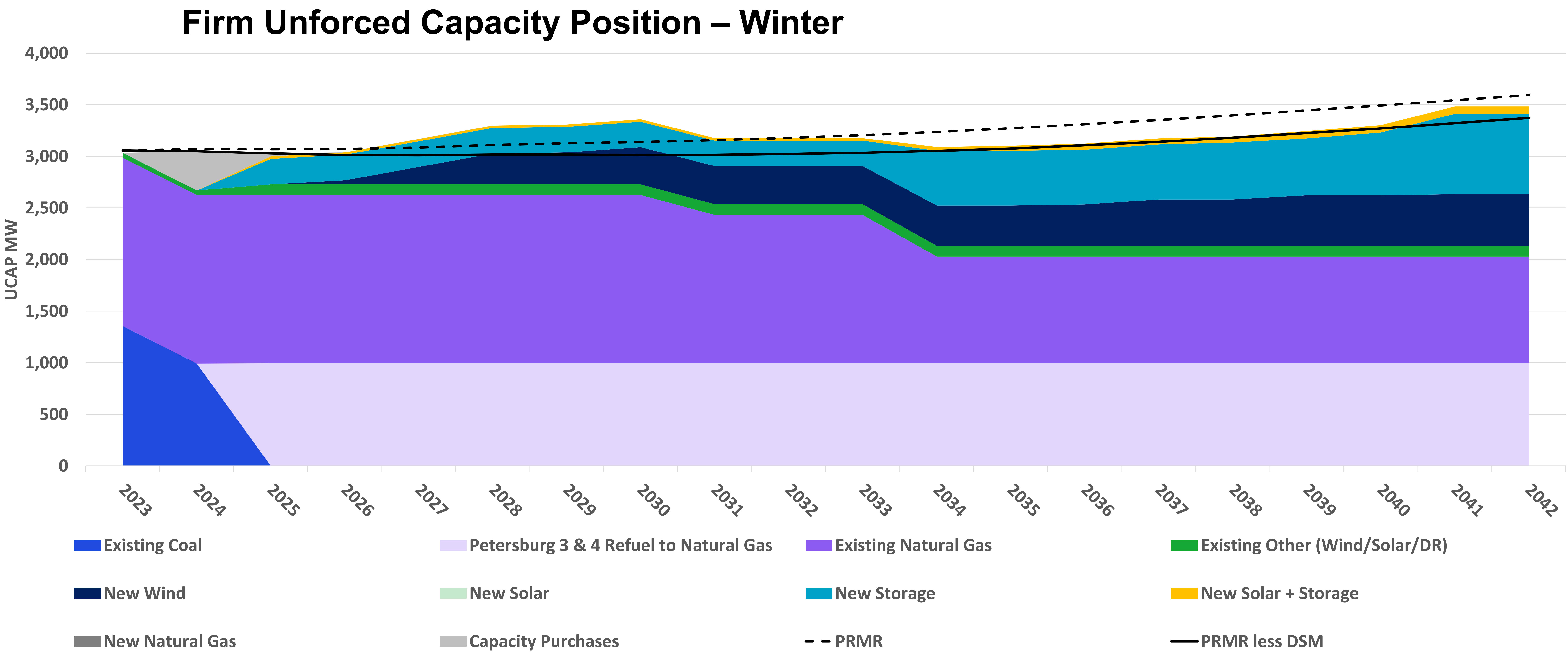
# B. Pete Refuel by 2025

| *20-Year PVRR (2023$MM, 2023-2042)* | Scenarios | | | |
|---|---|---|---|---|
| **Generation Strategy:** | **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| *Pete Refuel to 100% Gas (est. 2025)* | | | **$11,181** | |

# Pete 3 & 4 Refuel in 2025: Aggressive Environmental



# Pete 3 & 4 Refuel in 2025: Aggressive Environmental

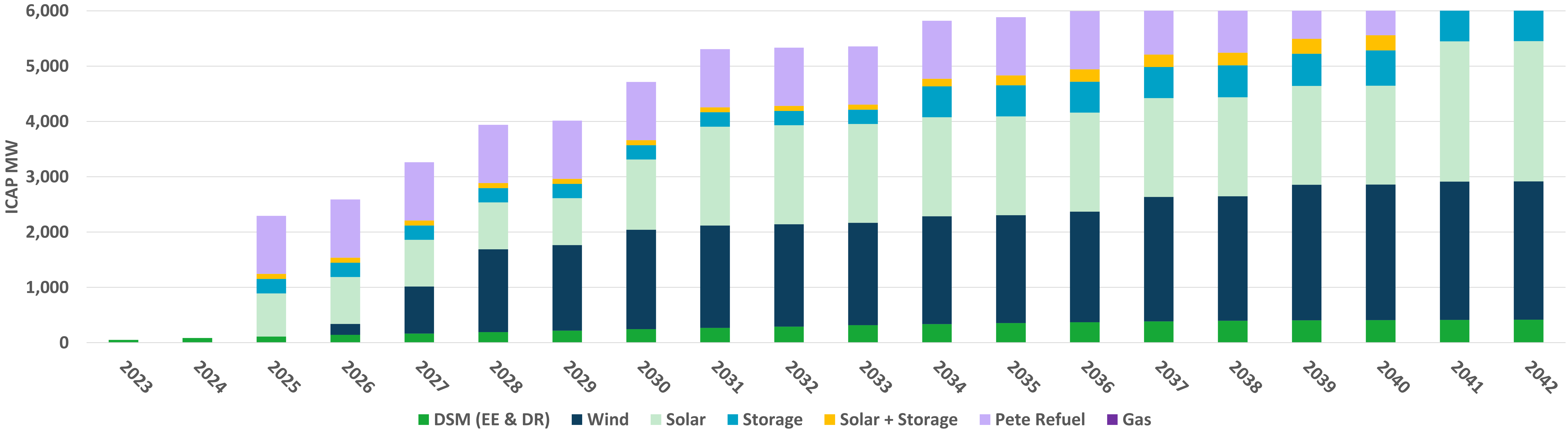




aes Indiana

# Pete 3 & 4 Refuel in 2025: Aggressive Environmental

## Installed Capacity Cumulative Additions (MW)



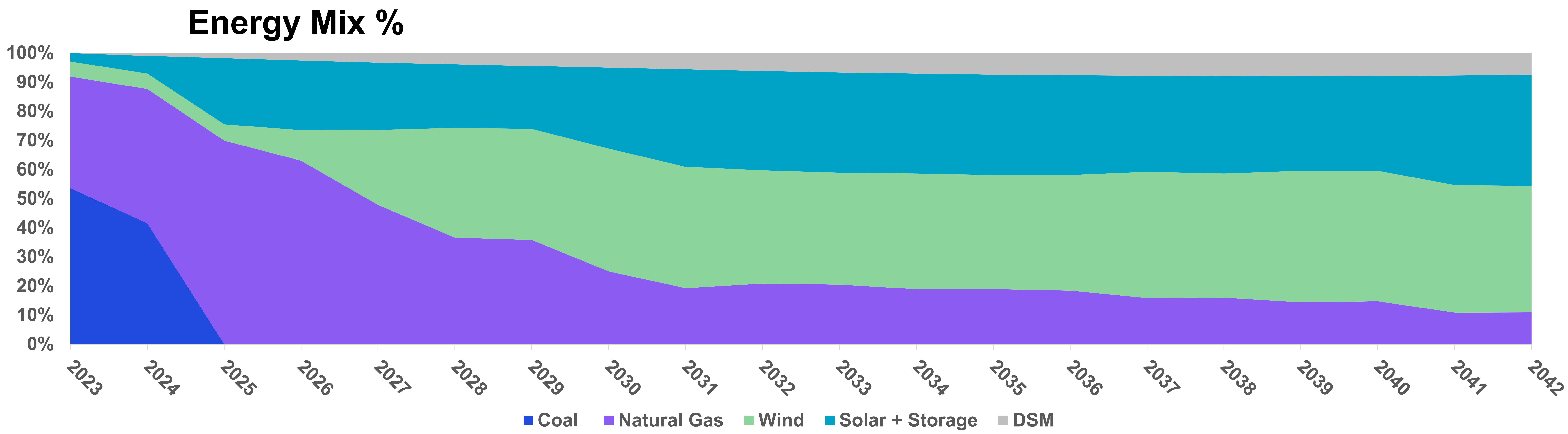

***Installed Capacity Incremental Additions (MW): 2023 - 2028***

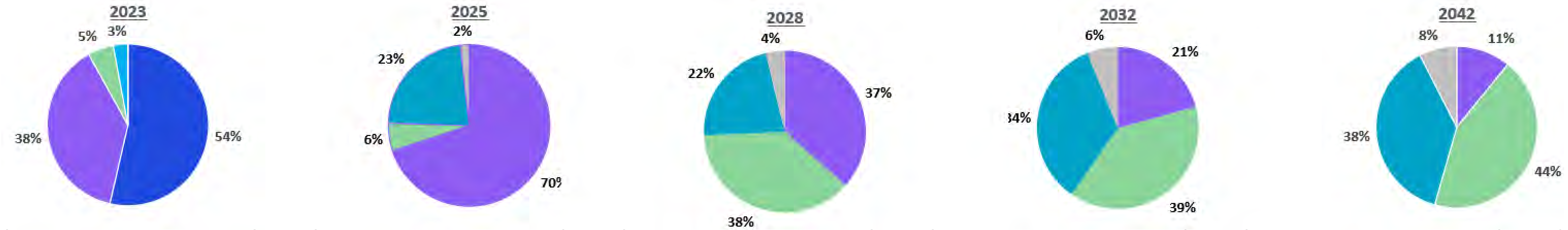
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 200 | 650 | 650 |
| Solar | 0 | 0 | 780 | 65 | 0 | 0 |
| Storage | 0 | 0 | 260 | 0 | 0 | 0 |
| Solar + Storage | 0 | 0 | 90 | 0 | 0 | 0 |
| Pete Refuel | 0 | 0 | 1,052 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |



aes Indiana

# Pete 3 & 4 Refuel in 2025: Aggressive Environmental




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 70% | Thermal MWh % | 37% | Thermal MWh % | 21% | Thermal MWh % | 11% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 30% | Renewable/DSM MWh % | 63% | Renewable/DSM MWh % | 79% | Renewable/DSM MWh % | 89% |

# Pete 3 & 4 Refuel in 2025: Aggressive Environmental

## Portfolio Overview

### *Retirements*

Petersburg:
- Pete 3 & 4 Coal: 2025 Refuel with Nat Gas
  - **Total Refueled MW: 1,040 MW**

Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 415 MW
- Wind: 2,500 MW
- Solar: 2,535 MW
- Storage: 820 MW
- Solar + Storage: 270 MW
- Thermal: 0
- Pete 3 & 4 Refueled to Nat Gas: 1,052 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | Aggressive Environmental |
| **No Early Retirement** | $11,349 |
| **Pete Refuel to 100% Gas (est. 2025)** | **$11,181** |
| **One Pete Unit Retires (2026)** | $11,470 |
| **Both Pete Units Retire (2026 & 2028)** | $11,145 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $11,184 |
| **Encompass Optimization without predefined Strategy** | $10,994 |



aes Indiana

# C. One Pete Unit Retires (2026)

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

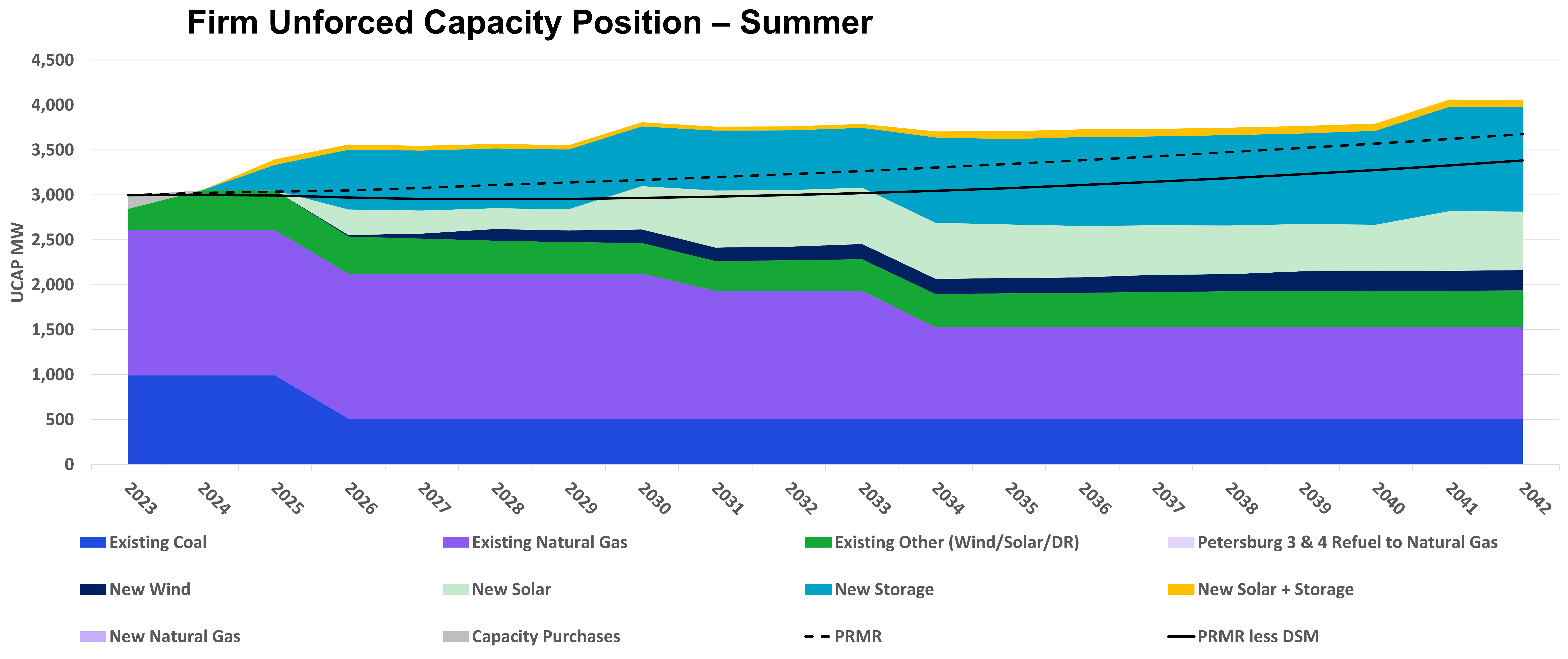
**Generation Strategy:** *One Pete Unit Retires (2026)*

| Scenarios | | | |
|---|---|---|---|
| No Environmental Action | Current Trends | Aggressive Environmental | Decarbonized Economy |
| | | $11,470 | |



aes Indiana

# One Pete Unit Retires (2026): Aggressive Environmental

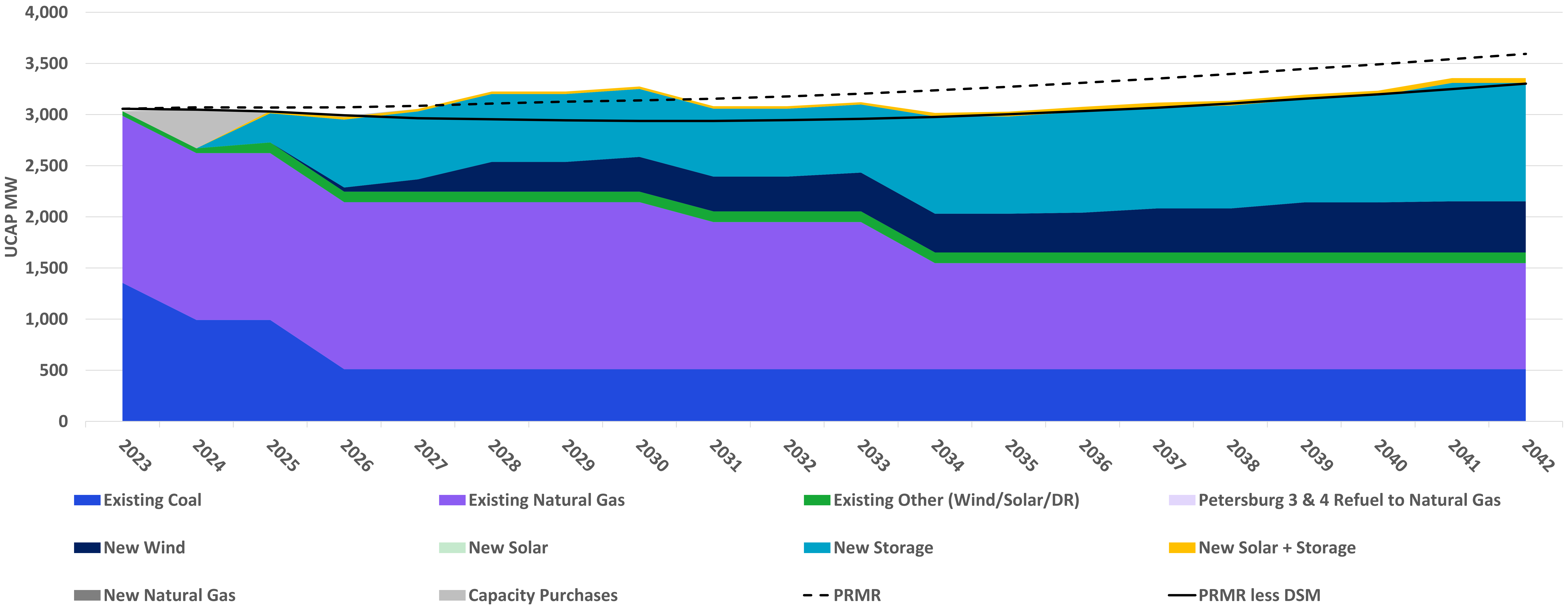





AES Indiana

# One Pete Unit Retires (2026): Aggressive Environmental

## Firm Unforced Capacity Position – Winter



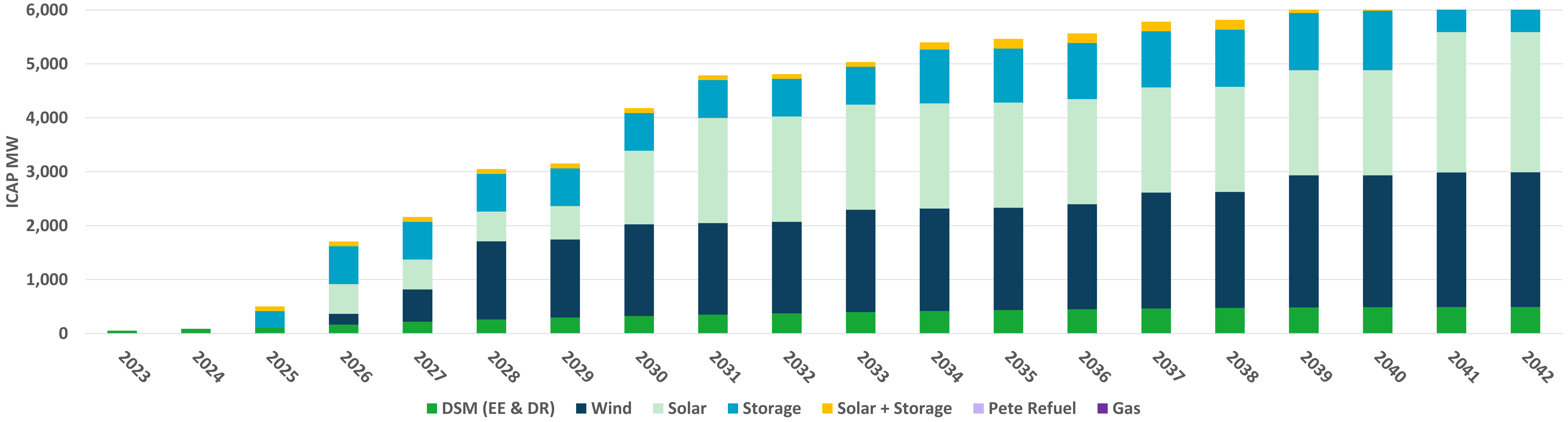





AES Indiana

# One Pete Unit Retires (2026): Aggressive Environmental

## Installed Capacity Cumulative Additions (MW)



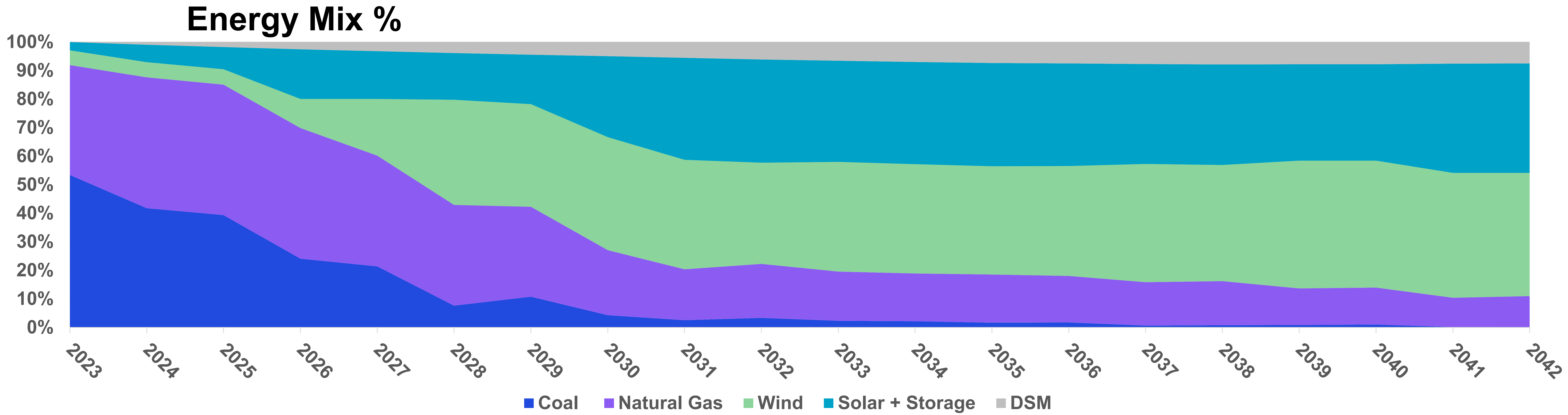

***Installed Capacity Incremental Additions (MW): 2023 - 2028***

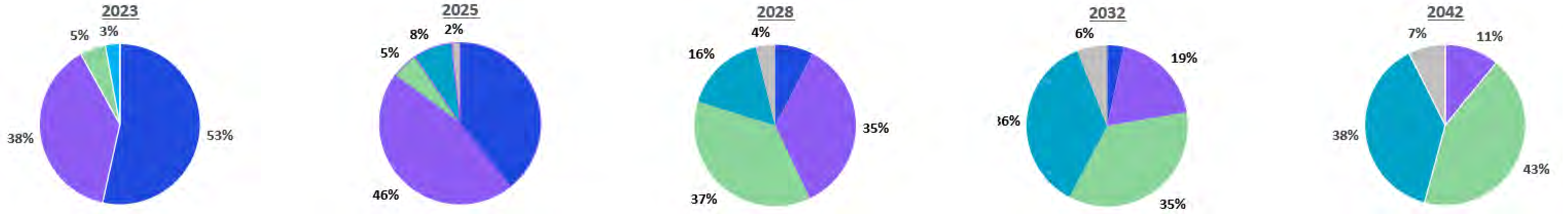
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 200 | 400 | 850 |
| Solar | 0 | 0 | 0 | 553 | 0 | 0 |
| Storage | 0 | 0 | 300 | 400 | 0 | 0 |
| Solar + Storage | 0 | 0 | 90 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |



aes Indiana

# One Pete Unit Retires (2026): Aggressive Environmental




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 85% | Thermal MWh % | 43% | Thermal MWh % | 22% | Thermal MWh % | 11% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 15% | Renewable/DSM MWh % | 57% | Renewable/DSM MWh % | 78% | Renewable/DSM MWh % | 89% |

# One Pete Unit Retires (2026): Aggressive Environmental

## Portfolio Overview

### *Retirements*

Petersburg:

- Pete 3 Coal: 2026
  - **Total Coal Retired MW: 520 MW**

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 490 MW
- Wind: 2,500 MW
- Solar: 2,600 MW
- Storage: 1,240 MW
- Solar + Storage: 180 MW
- Thermal: 0 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | Aggressive Environmental |
| No Early Retirement | $11,349 |
| Pete Refuel to 100% Gas (est. 2025) | $11,181 |
| One Pete Unit Retires (2026) | **$11,470** |
| Both Pete Units Retire (2026 & 2028) | $11,145 |
| "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | $11,184 |
| Encompass Optimization without predefined Strategy | $10,994 |



AES Indiana

# D. Both Pete Units Retire (2026 & 2028)

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

**Generation Strategy:** ***Both Pete Units Retire (2026 & 2028)***

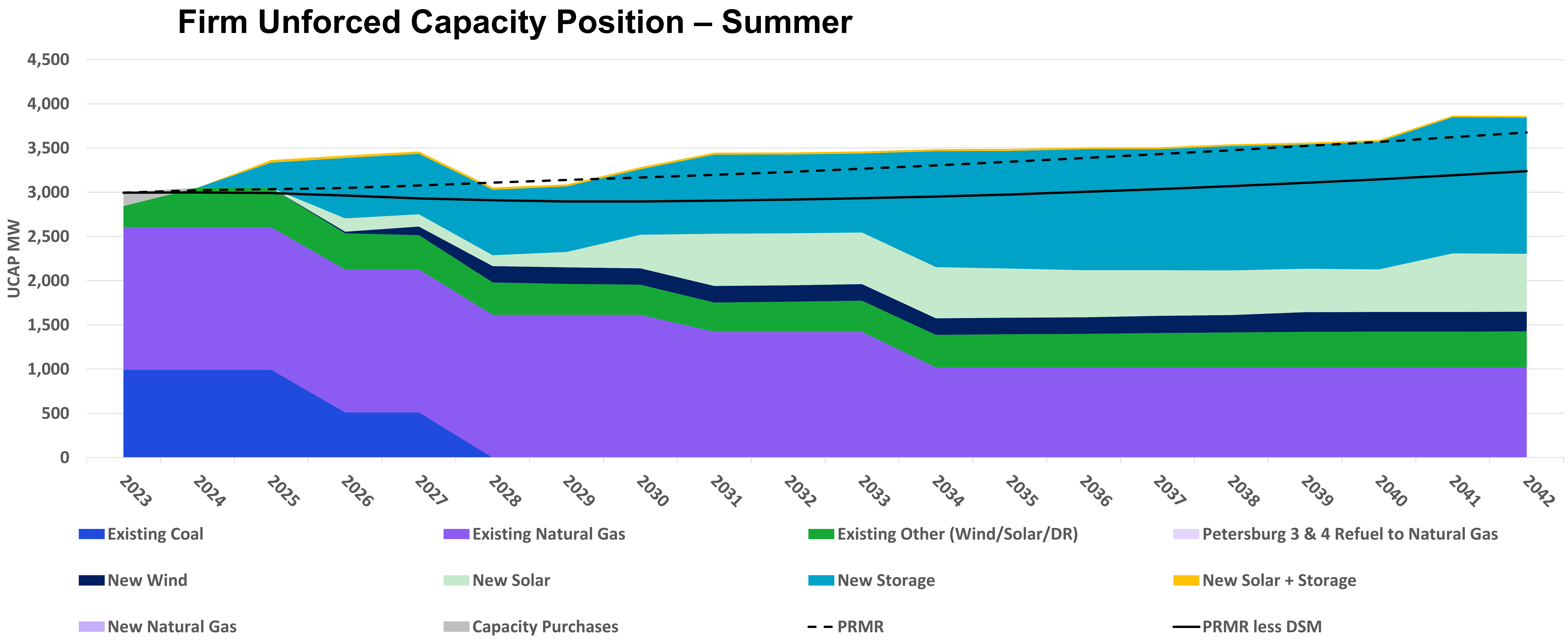
| Scenarios | | | |
|---|---|---|---|
| **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| | | **$11,145** | |



aes Indiana

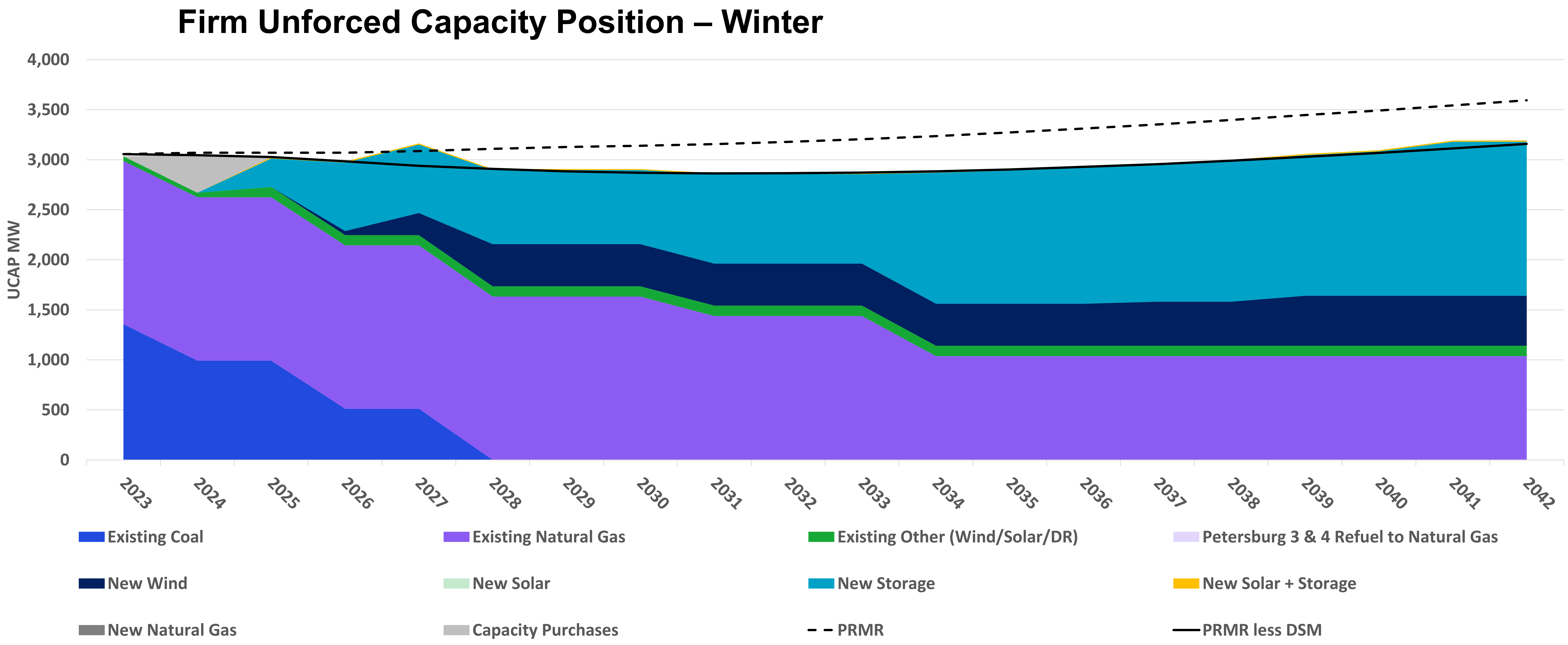
# Both Pete Units Retire: Aggressive Environmental

*2026 & 2028*



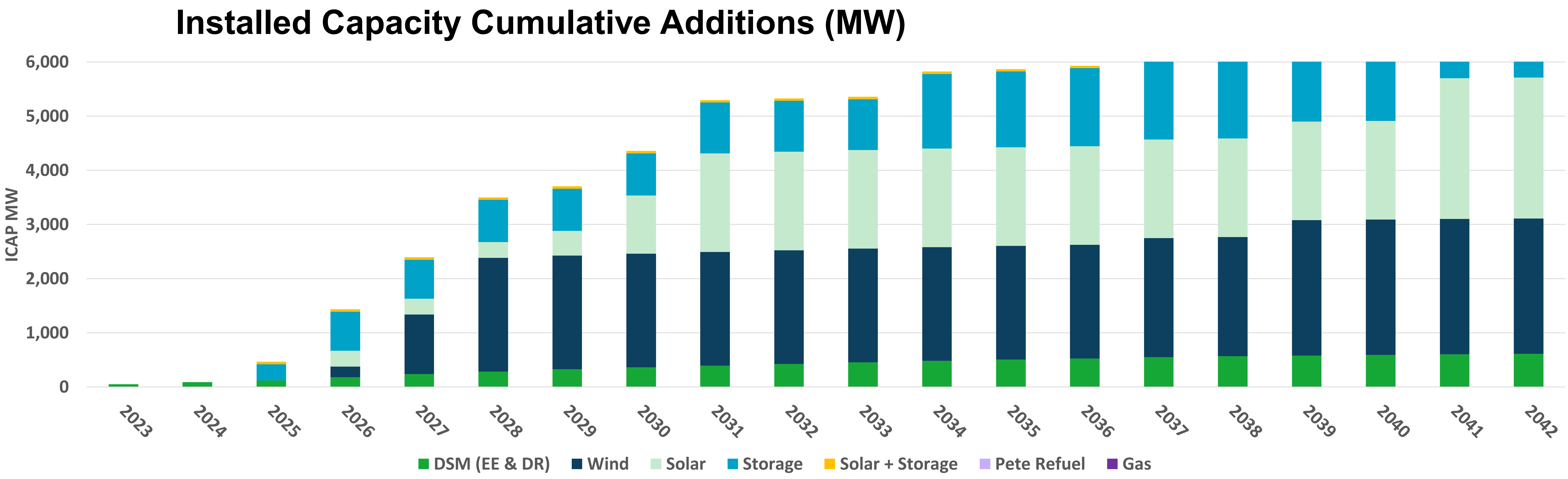
# Both Pete Units Retire: Aggressive Environmental

*2026 & 2028*



# Both Pete Units Retire: Aggressive Environmental

*2026 & 2028*




***Installed Capacity Incremental Additions (MW): 2023 – 2028***

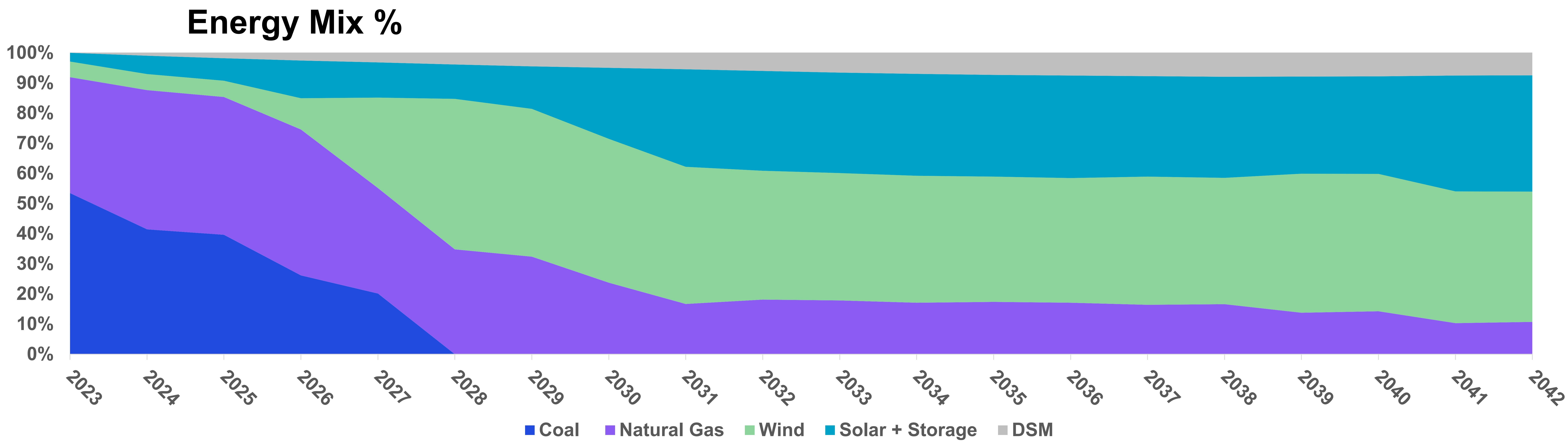
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 200 | 900 | 1,000 |
| Solar | 0 | 0 | 0 | 293 | 0 | 0 |
| Storage | 0 | 0 | 300 | 420 | 0 | 60 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |

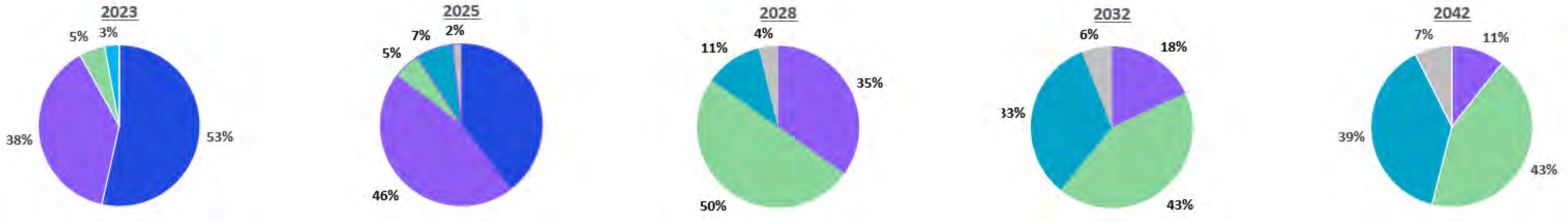


aes Indiana

# Both Pete Units Retire: Aggressive Environmental

*2026 & 2028*




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 85% | Thermal MWh % | 35% | Thermal MWh % | 18% | Thermal MWh % | 11% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 15% | Renewable/DSM MWh % | 65% | Renewable/DSM MWh % | 82% | Renewable/DSM MWh % | 89% |



aes Indiana

# Both Pete Units Retire: Aggressive Environmental

*2026 & 2028*

## Portfolio Overview

### *Retirements*

Petersburg:

- Pete 3 Coal: 2026
- Pete 4 Coal: 2028
  - **Total Coal Retired MW: 1,040 MW**

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 610 MW
- Wind: 2,500 MW
- Solar: 2,600 MW
- Storage: 1,620 MW
- Solar + Storage: 45 MW
- Thermal: 0 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | Aggressive Environmental |
| No Early Retirement | $11,349 |
| Pete Refuel to 100% Gas (est. 2025) | $11,181 |
| One Pete Unit Retires (2026) | $11,470 |
| Both Pete Units Retire (2026 & 2028) | **$11,145** |
| "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | $11,184 |
| Encompass Optimization without predefined Strategy | $10,994 |



aes Indiana

# E. Clean Energy Strategy

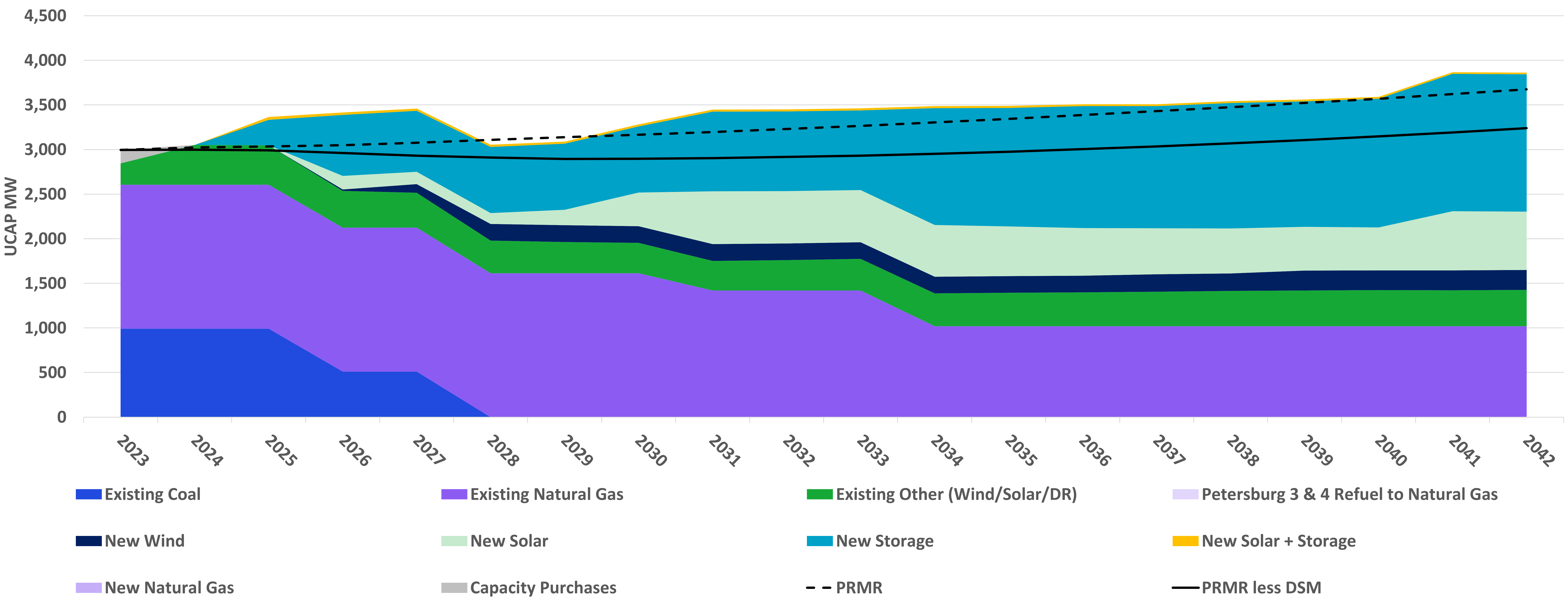
*Retire & Replace Pete with Clean Energy*

| *20-Year PVRR (2023$MM, 2023-2042)* | Scenarios | | | |
|---|---|---|---|---|
| **Generation Strategy:** *"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)* | **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| | | | **$11,184** | |

# Clean Energy Strategy: Aggressive Environmental

***Retire & Replace Pete with Clean Energy***

## Firm Unforced Capacity Position – Summer



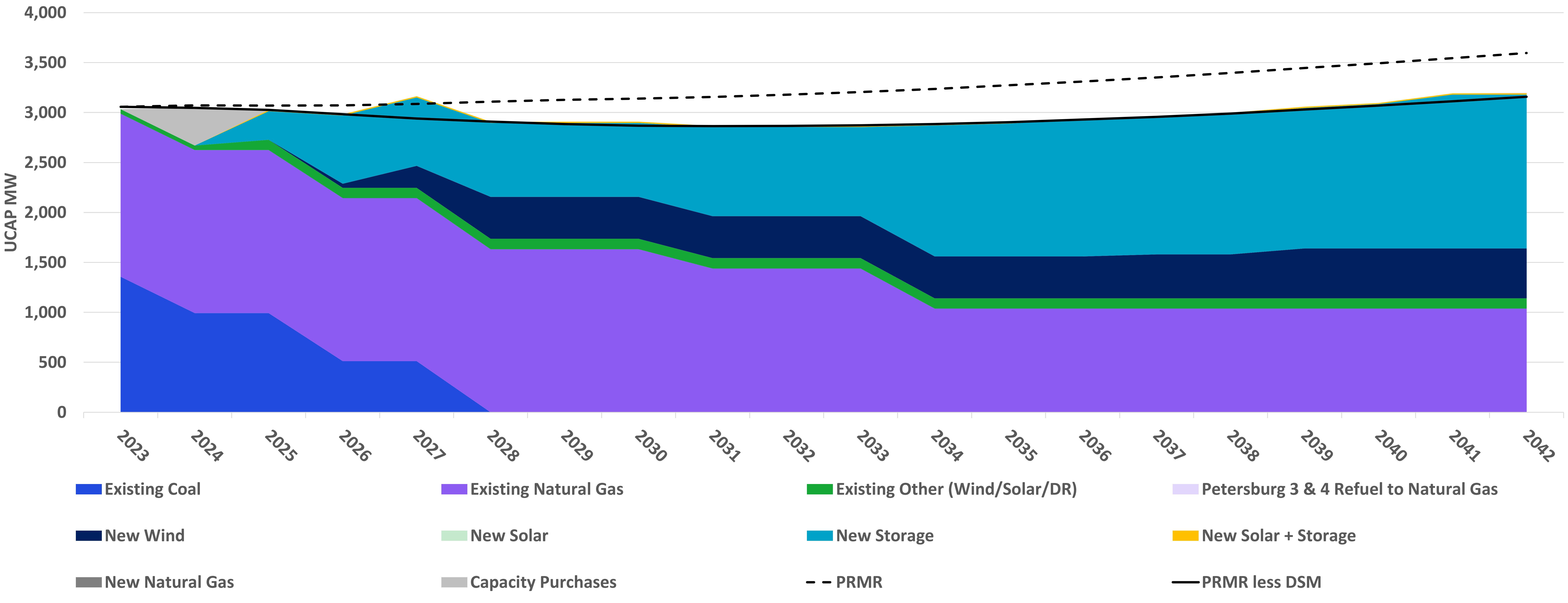



aes Indiana

# Clean Energy Strategy: Aggressive Environmental

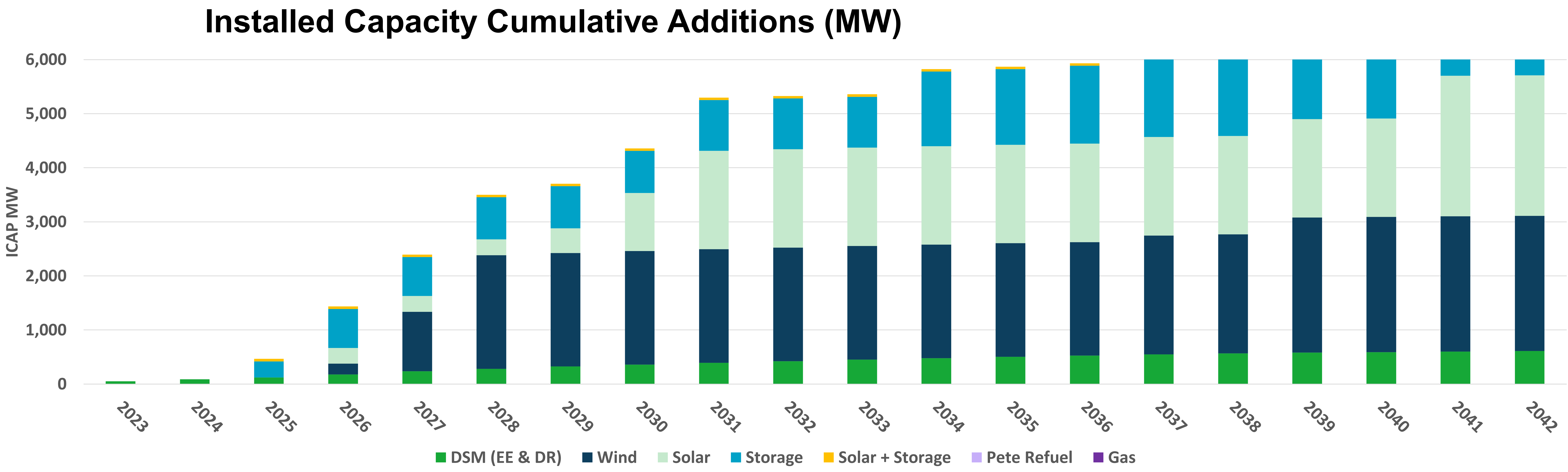
***Retire & Replace Pete with Clean Energy***

## Firm Unforced Capacity Position – Winter



# Clean Energy Strategy: Aggressive Environmental

*Retire & Replace Pete with Clean Energy*




*Installed Capacity Incremental Additions (MW): 2023 – 2028*

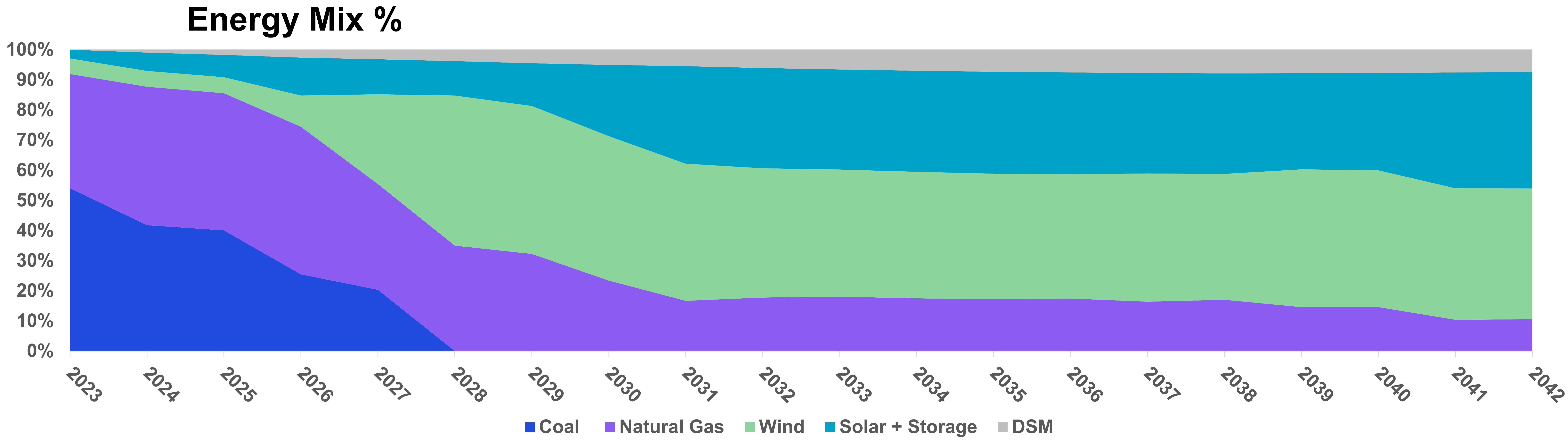
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 200 | 900 | 1,000 |
| Solar | 0 | 0 | 0 | 293 | 0 | 0 |
| Storage | 0 | 0 | 300 | 420 | 0 | 60 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |

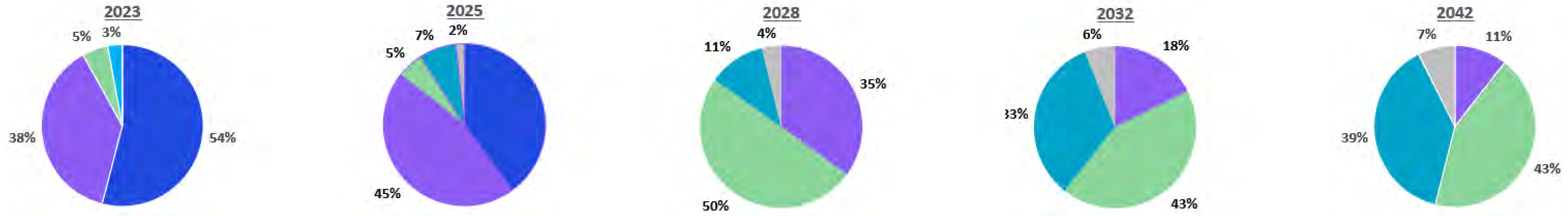


aes Indiana

# Clean Energy Strategy: Aggressive Environmental

***Retire & Replace Pete with Clean Energy***




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 86% | Thermal MWh % | 35% | Thermal MWh % | 18% | Thermal MWh % | 11% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 14% | Renewable/DSM MWh % | 65% | Renewable/DSM MWh % | 82% | Renewable/DSM MWh % | 89% |



aes Indiana

# Clean Energy Strategy: Aggressive Environmental

*Retire & Replace Pete with Clean Energy*

## Portfolio Overview

### Retirements

Petersburg:
- Pete 3 Coal: 2026
- Pete 4 Coal: 2028
  - **Total Coal Retired MW: 1,040 MW**

Harding Street:
- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Retired Nat Gas MW: 618 MW**

### Replacements by 2042

- DSM: 610 MW
- Wind: 2,500 MW
- Solar: 2,600 MW
- Storage: 1,620 MW
- Solar + Storage: 45 MW
- Thermal: 0 MW

### Current Trends PVRR Summary

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

| | Scenarios |
|---|---|
| | Aggressive Environmental |
| No Early Retirement | $11,349 |
| Pete Refuel to 100% Gas (est. 2025) | $11,181 |
| One Pete Unit Retires (2026) | $11,470 |
| Both Pete Units Retire (2026 & 2028) | $11,145 |
| "Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028) | **$11,184** |
| Encompass Optimization without predefined Strategy | $10,994 |



aes Indiana

# F. Encompass Optimization

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

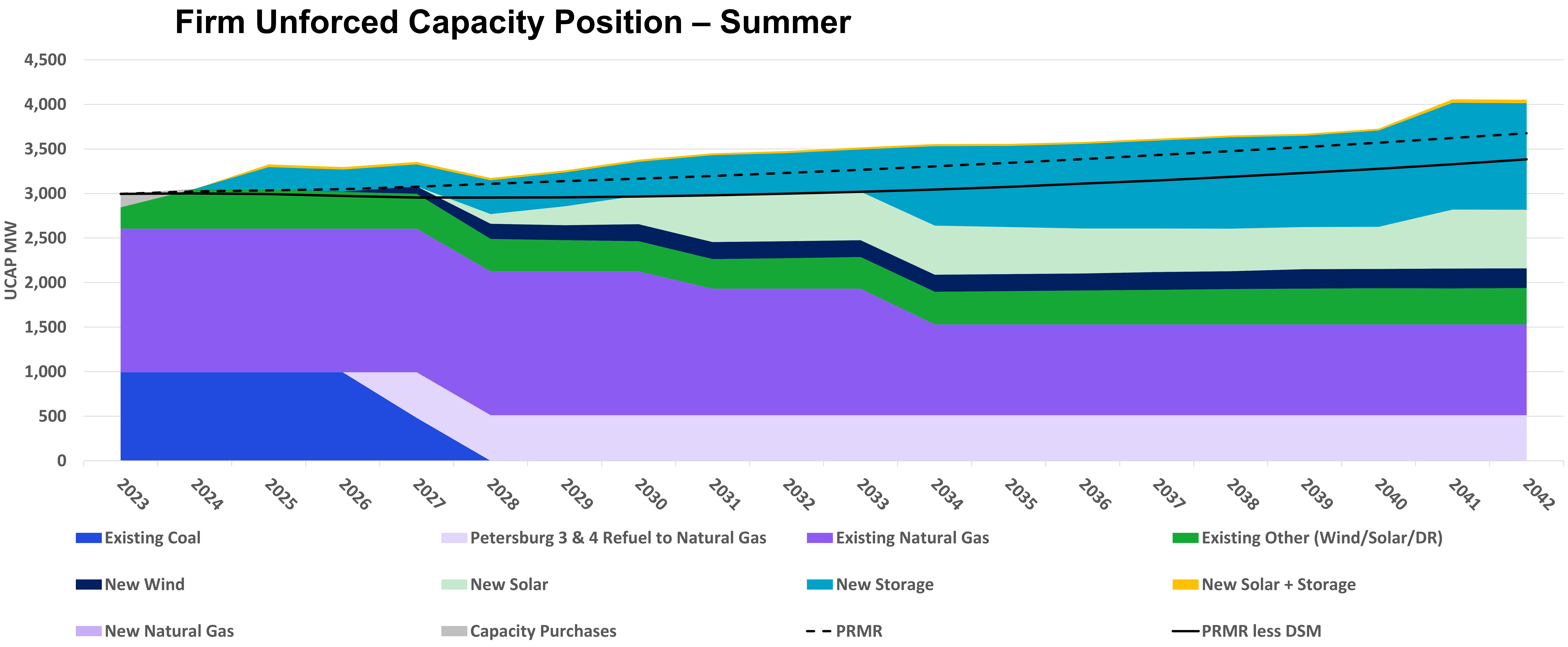
| ***20-Year PVRR (2023$MM, 2023-2042)*** <br> **Generation Strategy:** ***Encompass Optimization without predefined Strategy – Selects Pete 4 Refuel in 2027*** | **Scenarios** | | | |
|---|---|---|---|---|
| | **No Environmental Action** | **Current Trends** | **Aggressive Environmental** | **Decarbonized Economy** |
| | | | **$10,994** | |



aes Indiana

# Encompass Optimization: Aggressive Environmental

***Selects Pete 4 Refuel in 2027***

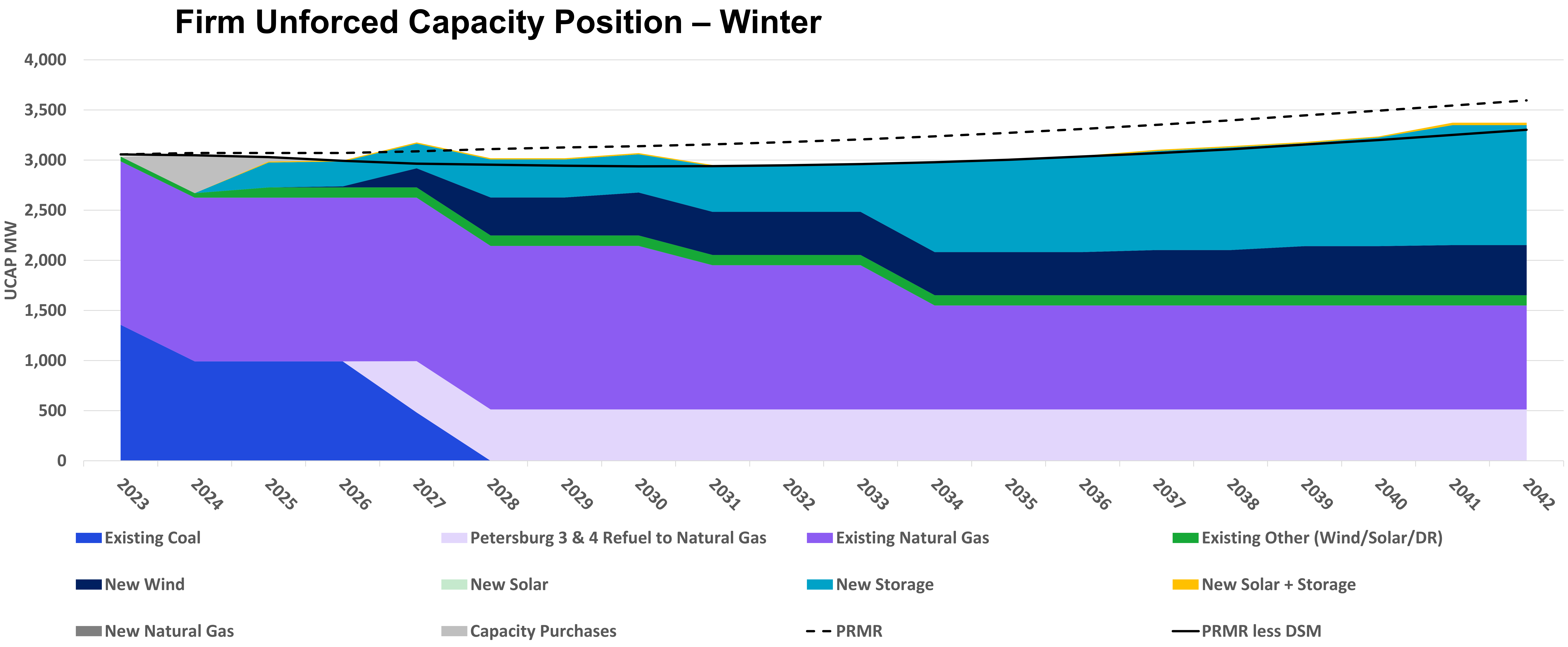





aes Indiana

# Encompass Optimization: Aggressive Environmental

***Selects Pete 4 Refuel in 2027***

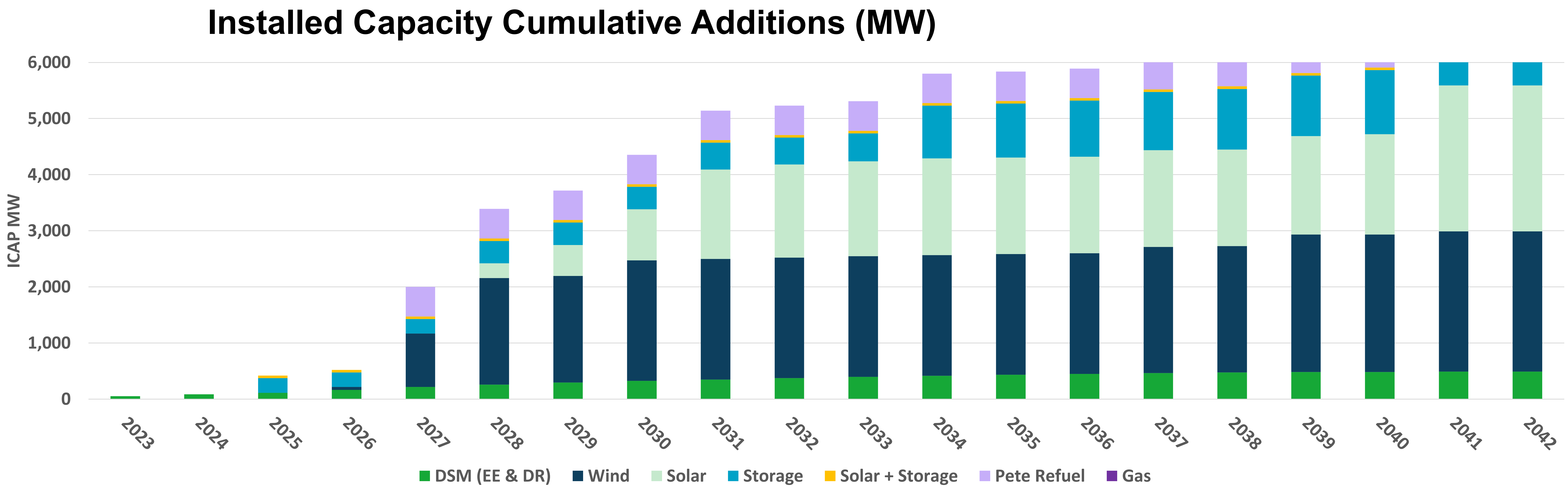





AES Indiana

# Encompass Optimization: Aggressive Environmental

*Selects Pete 4 Refuel in 2027*




***Installed Capacity Incremental Additions (MW): 2023 - 2028***

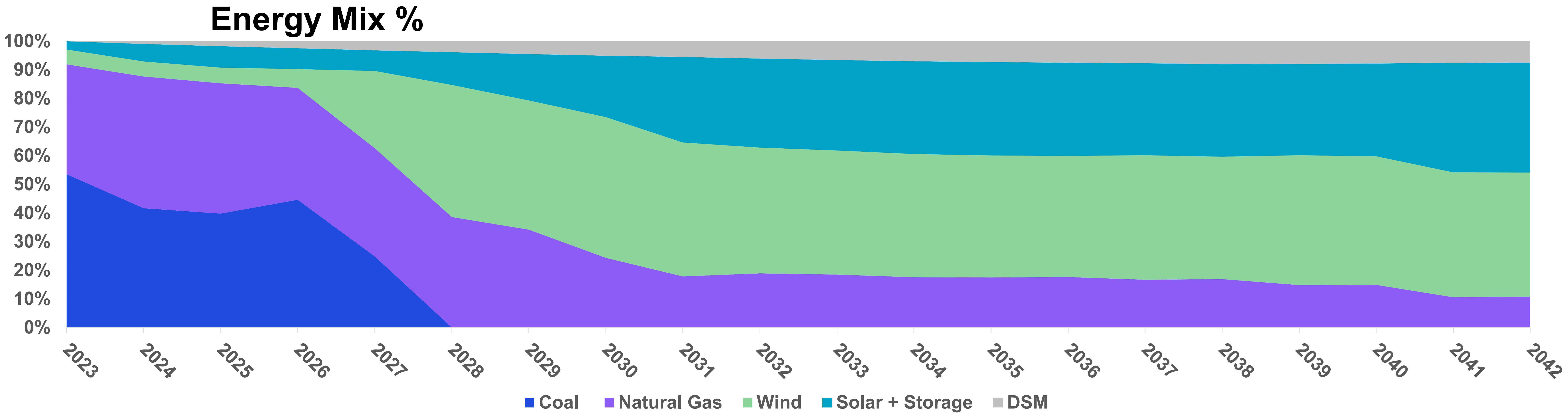
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|
| Wind | 0 | 0 | 0 | 50 | 900 | 950 |
| Solar | 0 | 0 | 0 | 0 | 0 | 260 |
| Storage | 0 | 0 | 260 | 0 | 0 | 140 |
| Solar + Storage | 0 | 0 | 45 | 0 | 0 | 0 |
| Pete Refuel | 0 | 0 | 0 | 0 | 526 | 0 |
| Gas | 0 | 0 | 0 | 0 | 0 | 0 |

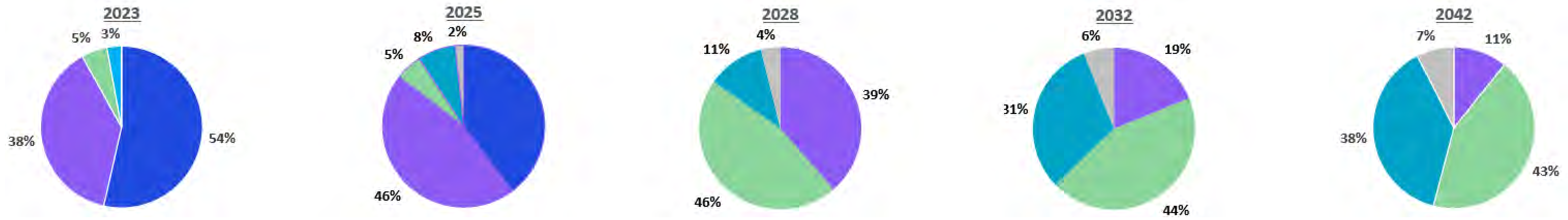


aes Indiana

# Encompass Optimization: Aggressive Environmental

***Selects Pete 4 Refuel in 2027***




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thermal MWh % | 92% | Thermal MWh % | 85% | Thermal MWh % | 39% | Thermal MWh % | 19% | Thermal MWh % | 11% |
| Renewable/DSM MWh % | 8% | Renewable/DSM MWh % | 15% | Renewable/DSM MWh % | 61% | Renewable/DSM MWh % | 81% | Renewable/DSM MWh % | 89% |



aes Indiana

# Encompass Optimization: Aggressive Environmental

*Selects Pete 4 Refuel in 2027*

## Portfolio Overview

### *Retirements*

Petersburg:

- Pete 3 Coal: 2028 – Retired 520 MW
- Pete 4 Coal: 2026 – Refueled 520 MW

Harding Street:

- HS ST5 Nat Gas: 2030
- HS ST6 Nat Gas: 2030
- HS ST7 Nat Gas: 2033
  - **Total Nat Gas Retired MW: 618 MW**

### *Replacement Additions by 2042*

- DSM: 490 MW
- Wind: 2,500 MW
- Solar: 2,600 MW
- Storage: 1,260 MW
- Solar + Storage: 90 MW
- Thermal: 0
- Pete 4 Refueled to Nat Gas: 526 MW

### *Current Trends PVRR Summary*

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

| | Scenarios |
|---|---|
| | **Aggressive Environmental** |
| **No Early Retirement** | $11,349 |
| **Pete Refuel to 100% Gas (est. 2025)** | $11,181 |
| **One Pete Unit Retires (2026)** | $11,470 |
| **Both Pete Units Retire (2026 & 2028)** | $11,145 |
| **"Clean Energy Strategy" Both Pete Units Retire and Replaced with Wind, Solar & Storage (2026 & 2028)** | $11,184 |
| **Encompass Optimization without predefined Strategy** | **$10,994** |



aes Indiana

# Portfolio Matrix

| *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 | Refuels Petersburg Unit 3 in 2025 & Refuels Petersburg Unit 4 in 2027 |



AES Indiana

# 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**<br>**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**<br>**12:00 PM – 12:30 PM** | Lunch | |
| **Afternoon**<br>**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 | |

# 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 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**.

# 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

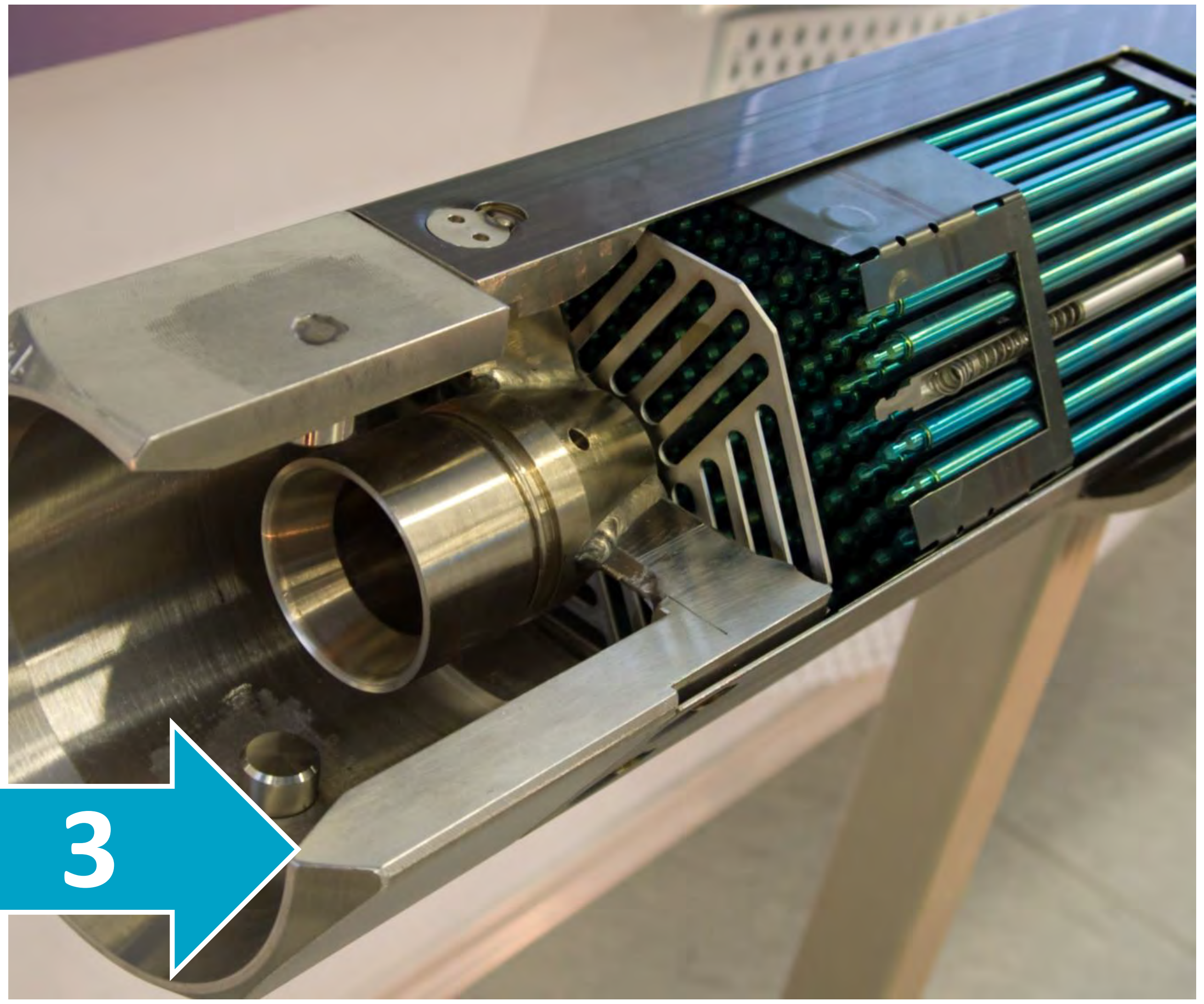
### Eagle Valley

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

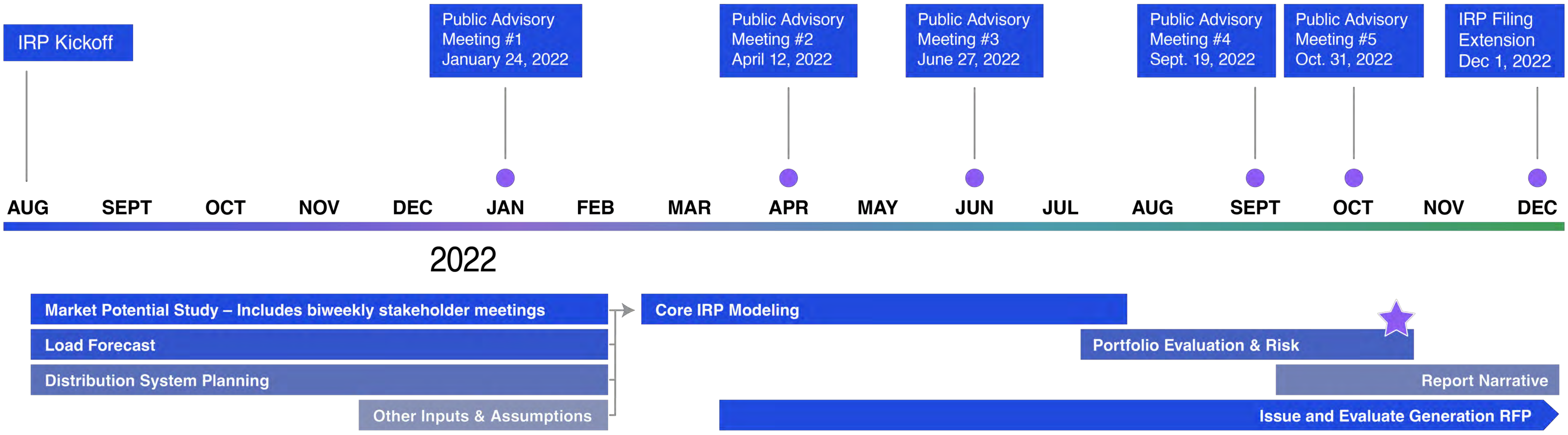
## SUSTAINABILITY

- → 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


aes Indiana

# 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**



aes Indiana

# 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**



aes Indiana

*Risk & Opportunity Metrics:*

# 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.

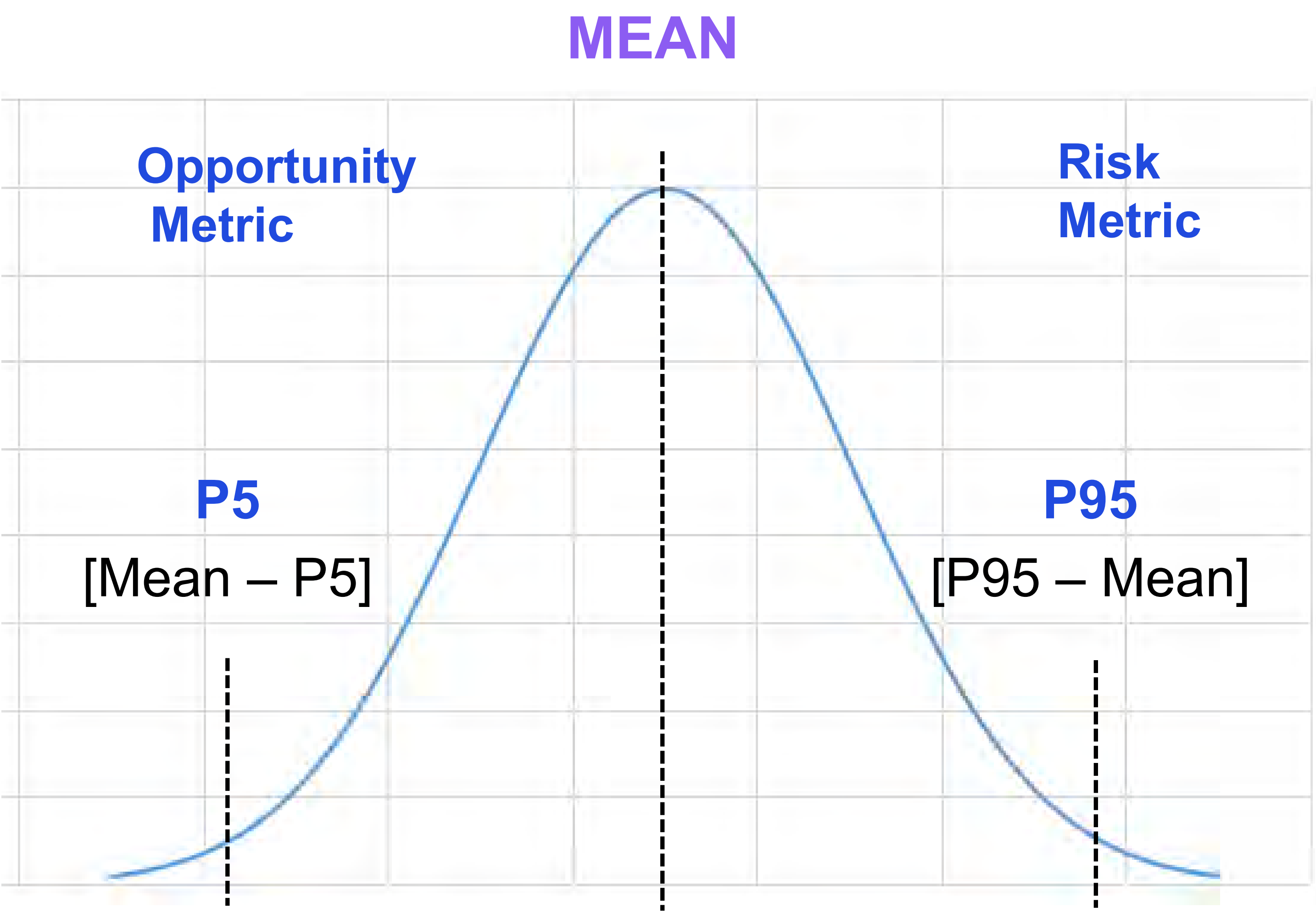


aes Indiana

*Risk & Opportunity Metrics:*

# 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]



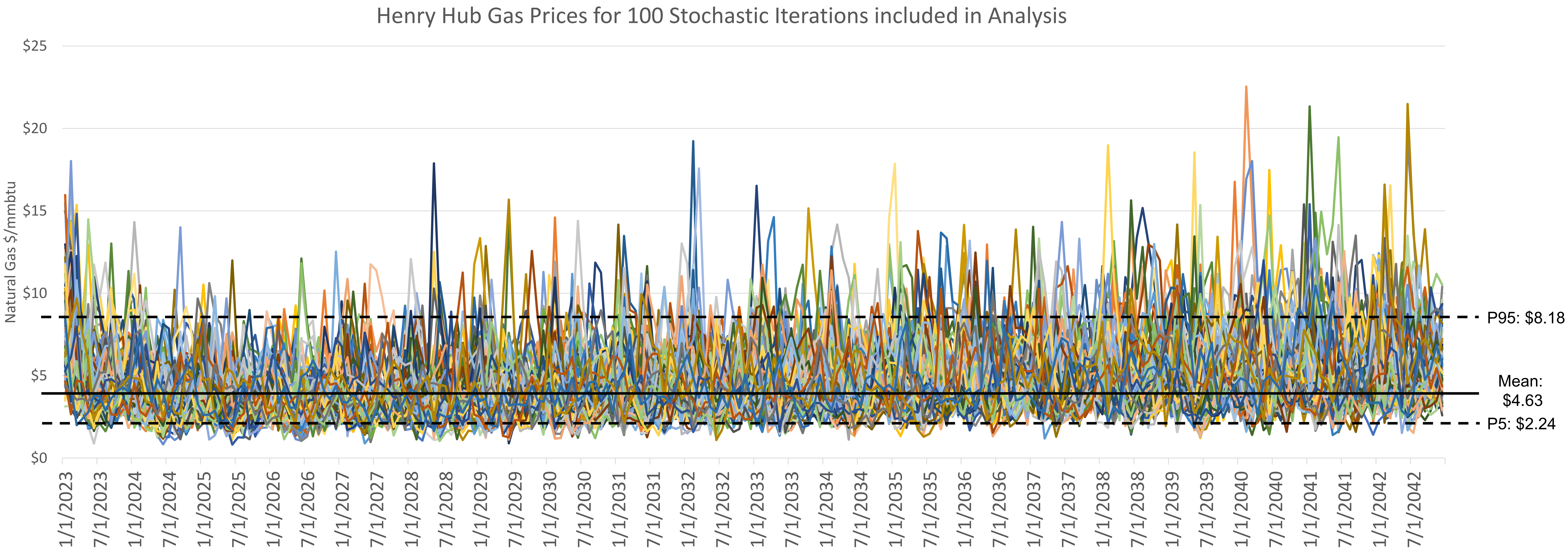



AES Indiana

*Risk & Opportunity Metrics:*

# Cost Risk & Opportunity Metric **Stochastic Analysis**

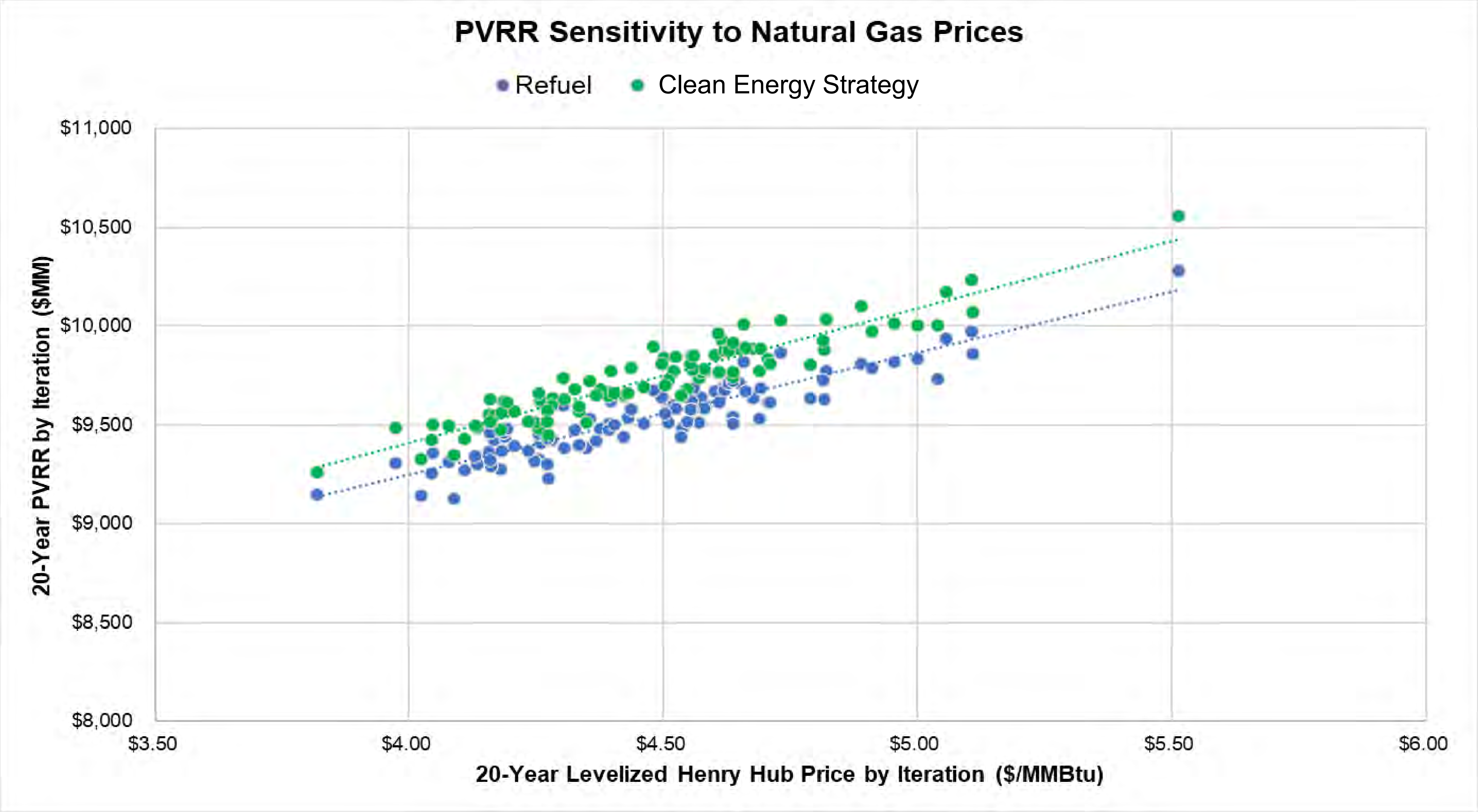
In order to fully evaluate commodity risk, the stochastic analysis captures recent volatility in commodity prices in forecasted distributions.



*Risk & Opportunity Metrics:*

# Cost Risk & Opportunity Metric **Stochastic Analysis**

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






aes Indiana

*Risk & Opportunity Metrics:*

# Cost Risk & Opportunity Metric **Stochastic Analysis**

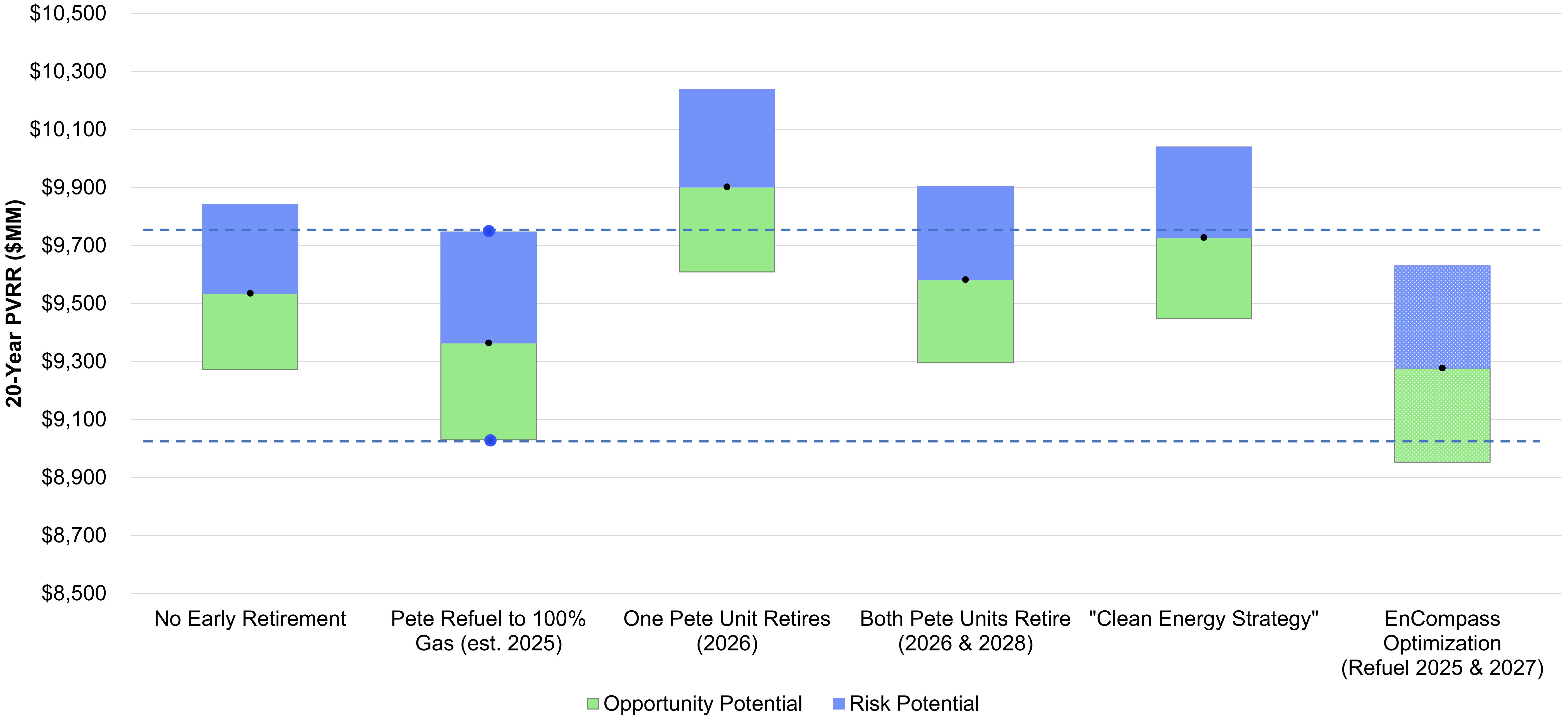
- For the stochastic analysis, AES Indiana lifted the energy constraints in Encompass to fully assess portfolio risk which results in a slightly different mean compared to the deterministic results.
- Risk: P95 – Indicates that 95% of potential PVRRs will fall below this value – there's a 5% chance PVRR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

*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.

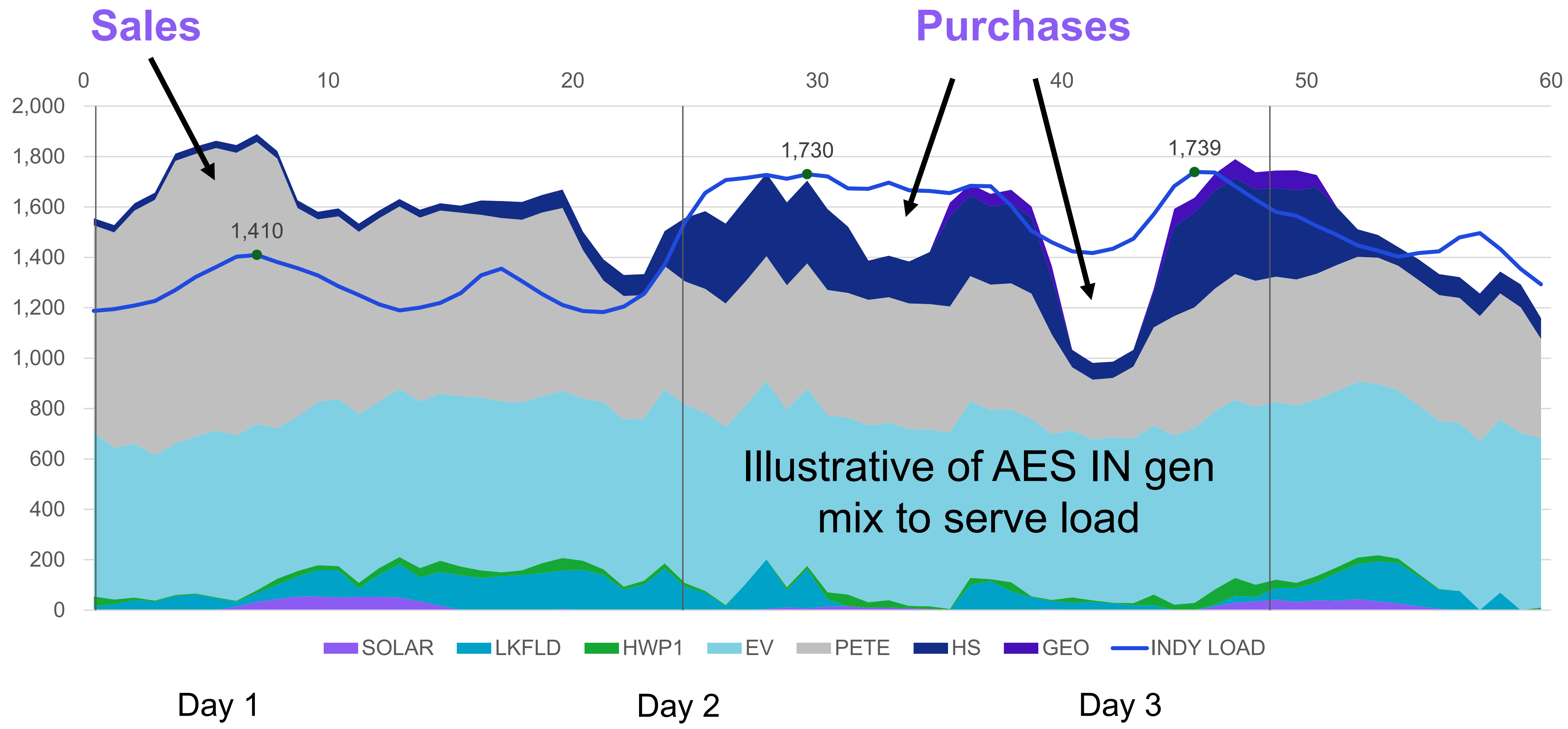


AES Indiana

*Risk & Opportunity Metrics:*

# 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.***



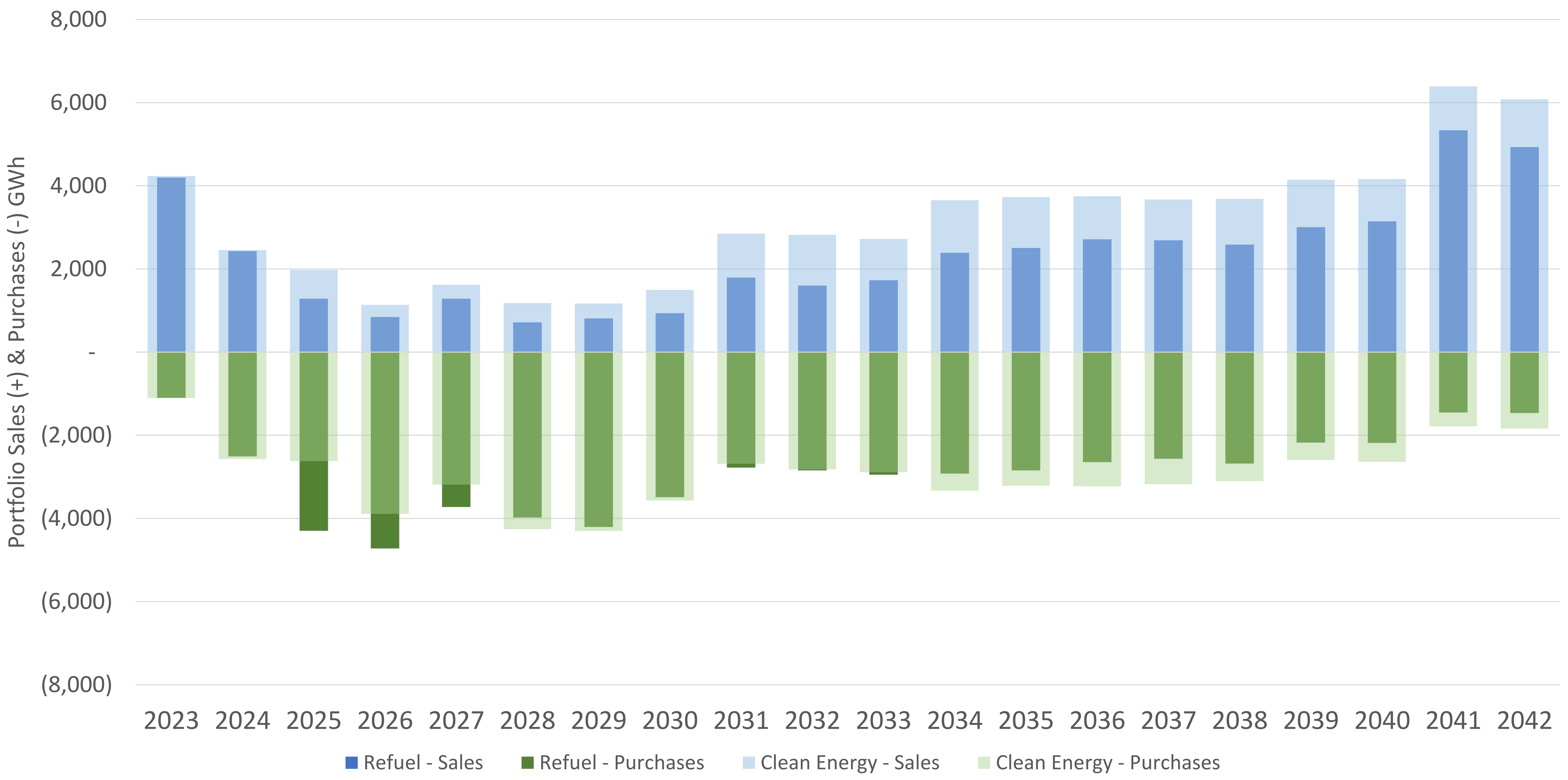
aes Indiana

*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

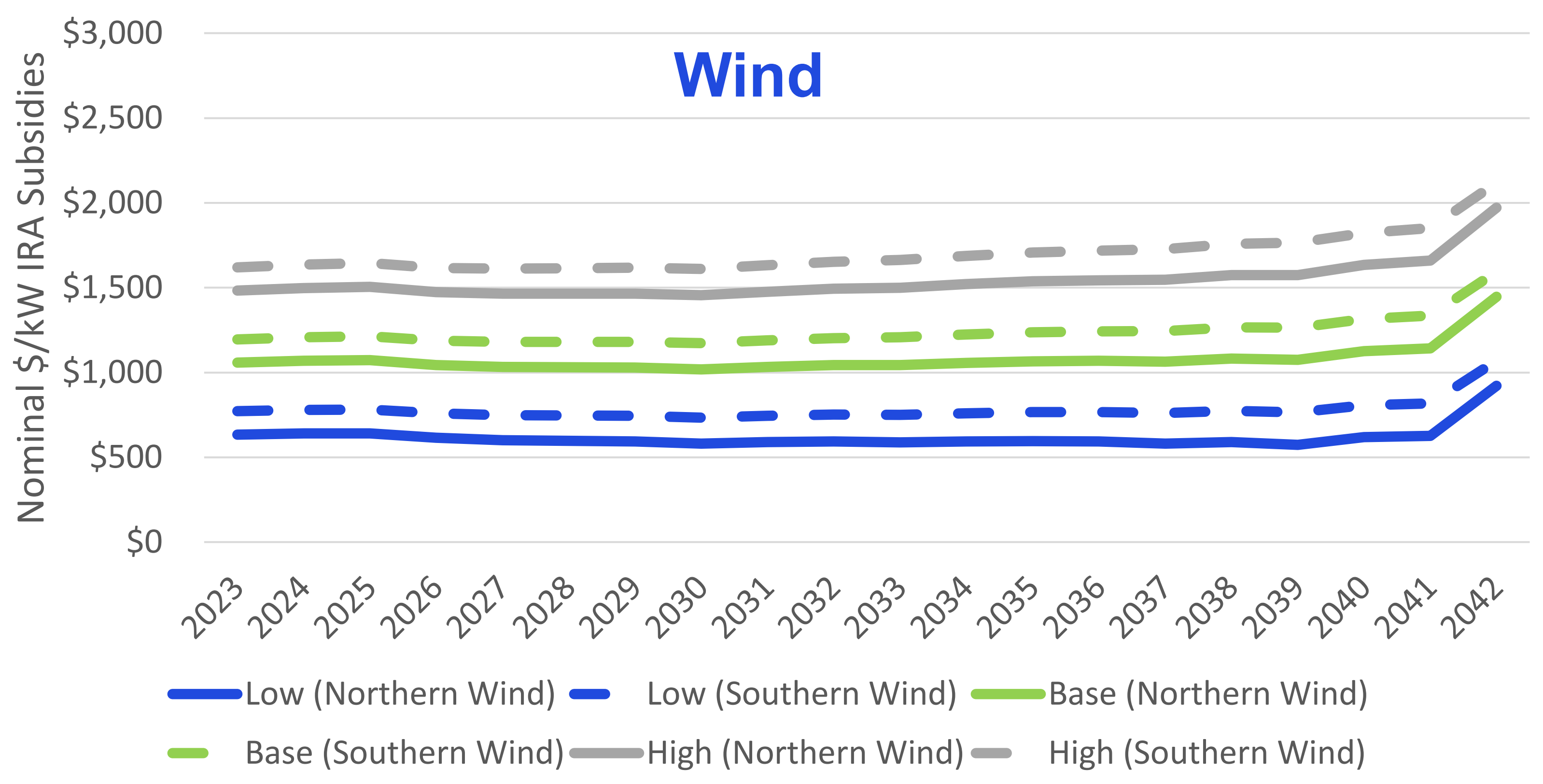
The Renewable Resource Capital Cost Sensitivity Analysis evaluates how much the Candidate Portfolio's PVRRs would change if renewable resource costs end up being higher or lower than the base assumptions.

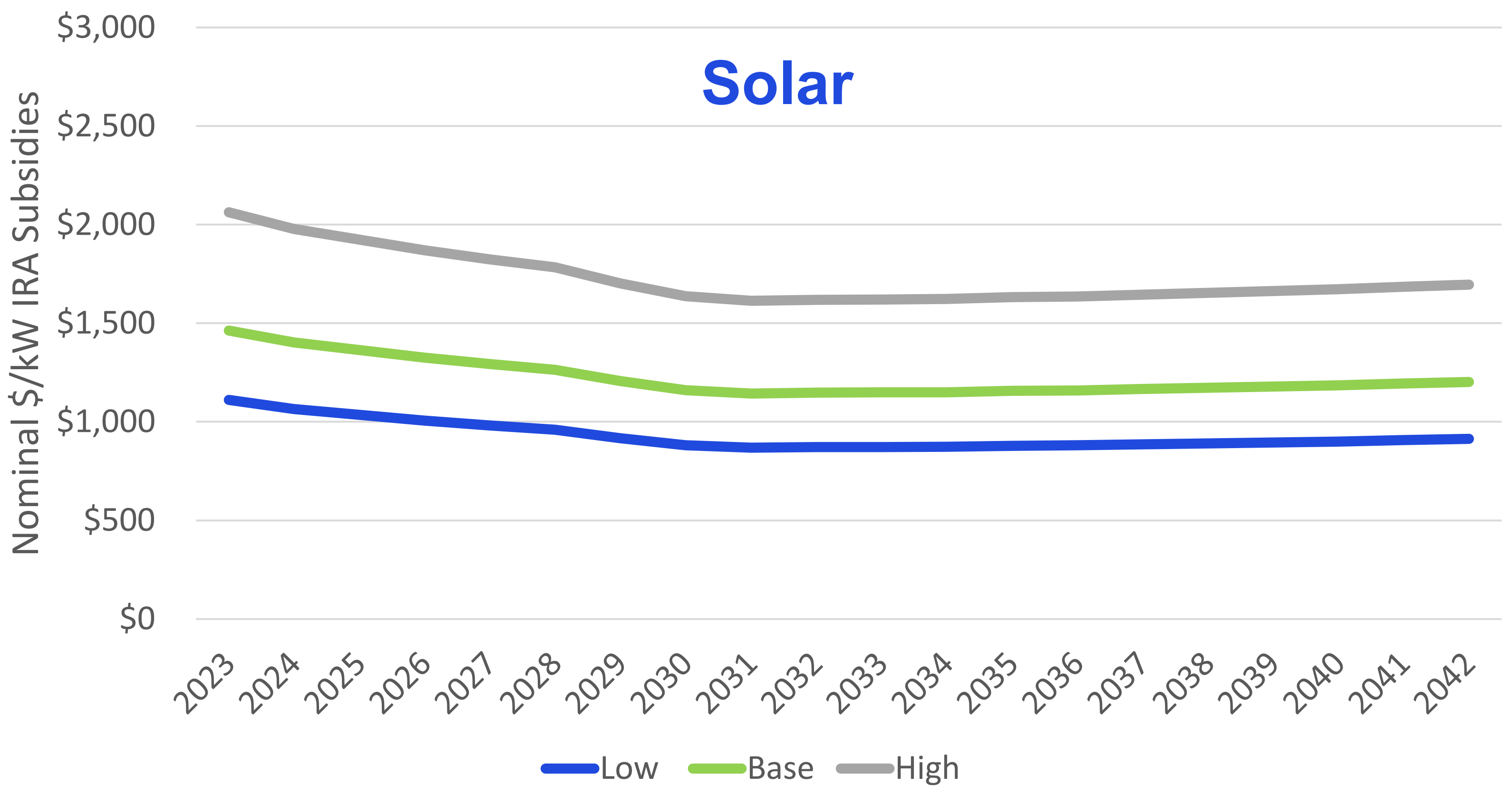
## How the analysis was performed

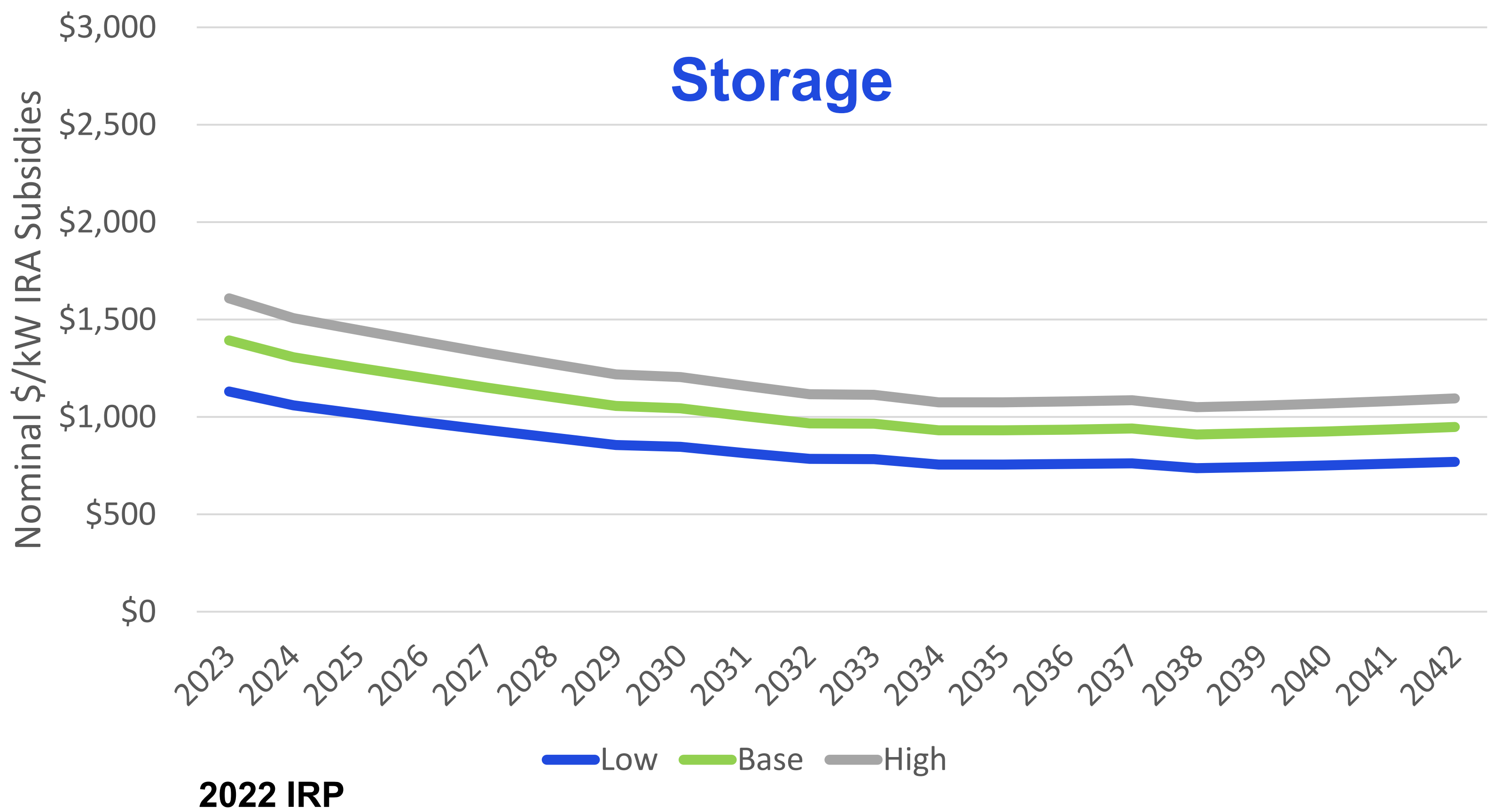
- Using secondary data sources and the responses from AES Indiana's past two RFPs that were issued in 2020 and the spring of 2022, the IRP team created low, base and high levels of renewable resource capital costs.
  - Low – low costs were based on the avg of the 2021 replacement resource capital cost 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.**

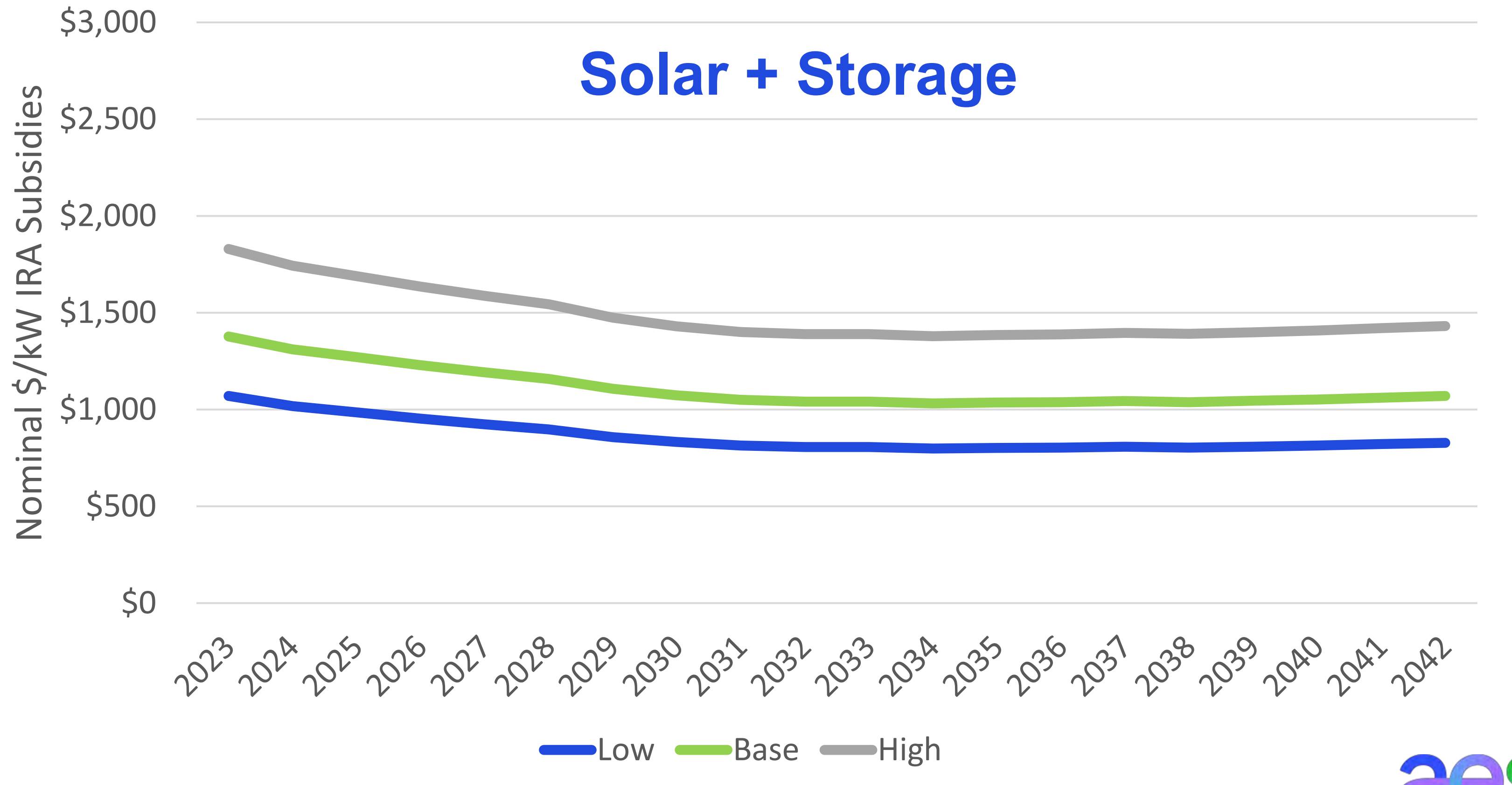
*Risk & Opportunity Metrics:*

# Renewable Resource Capital Costs – Low, Base & High





aes Indiana

*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



aes Indiana

# Break for Lunch

| Time | Topic | Speakers |
| --- | --- | --- |
| **Break**<br>**12:00 PM – 12:30 PM** | Lunch | |
| **Afternoon**<br>**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

# Reliability, Resiliency & Stability Metric

**Hisham Othman**, VP Transmission & Regulatory Consulting, Quanta

# Integrated Resource Plan (IRP) 2022

## Reliability Analysis of IRP Portfolios: Final Report

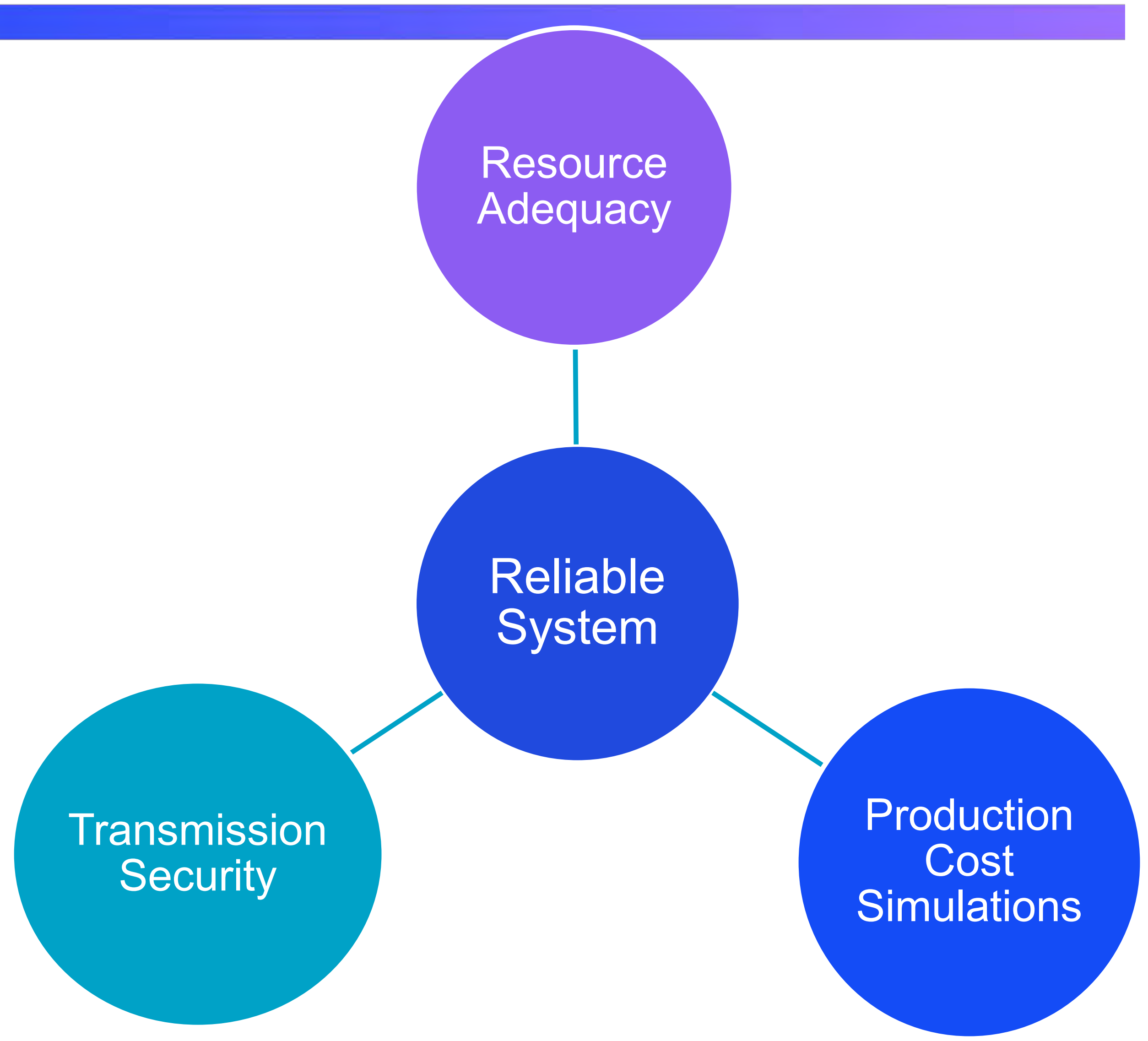
October 19, 2022

Presented by IRP Partner

QUANTA TECHNOLOGY

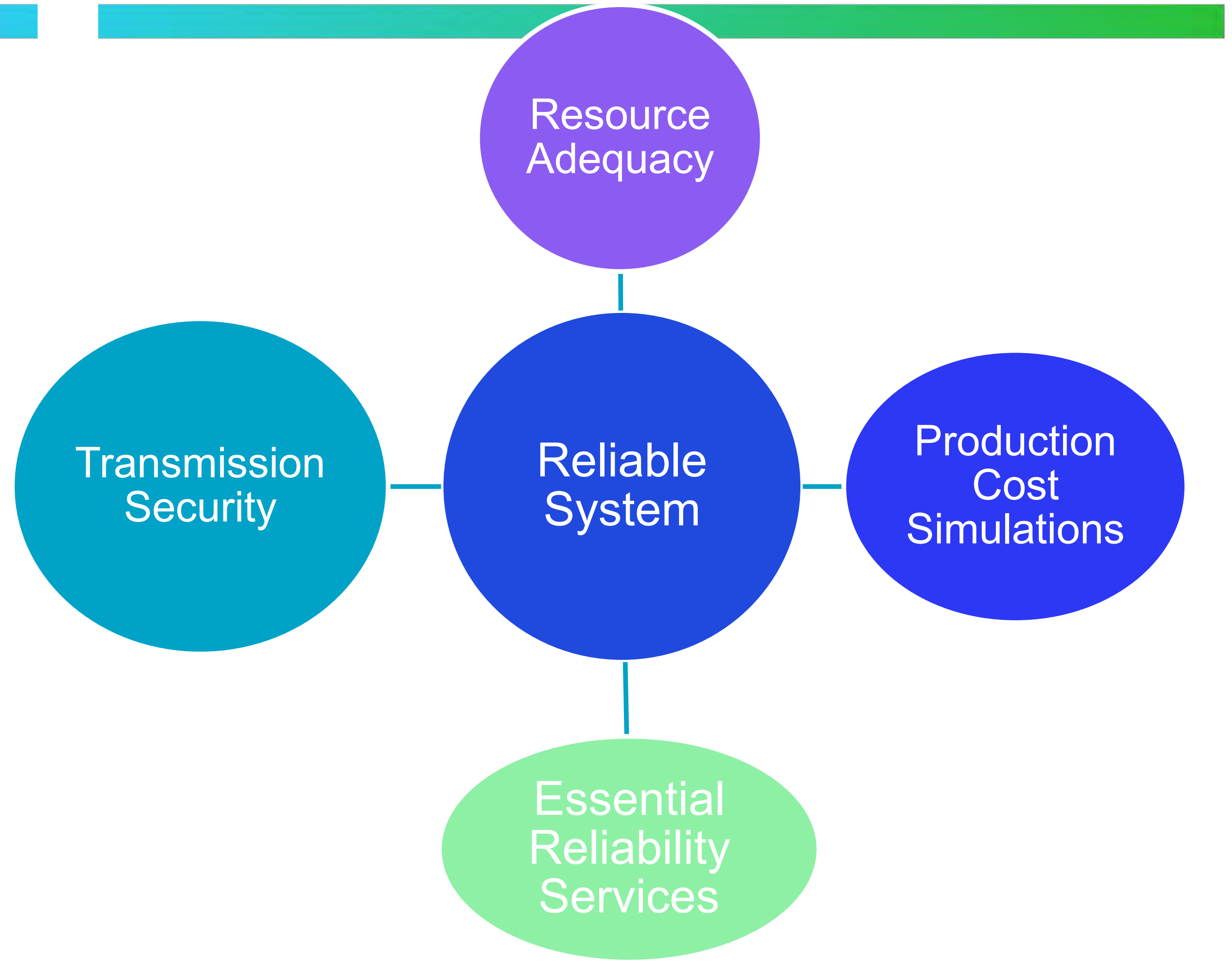
aes Indiana

# 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.

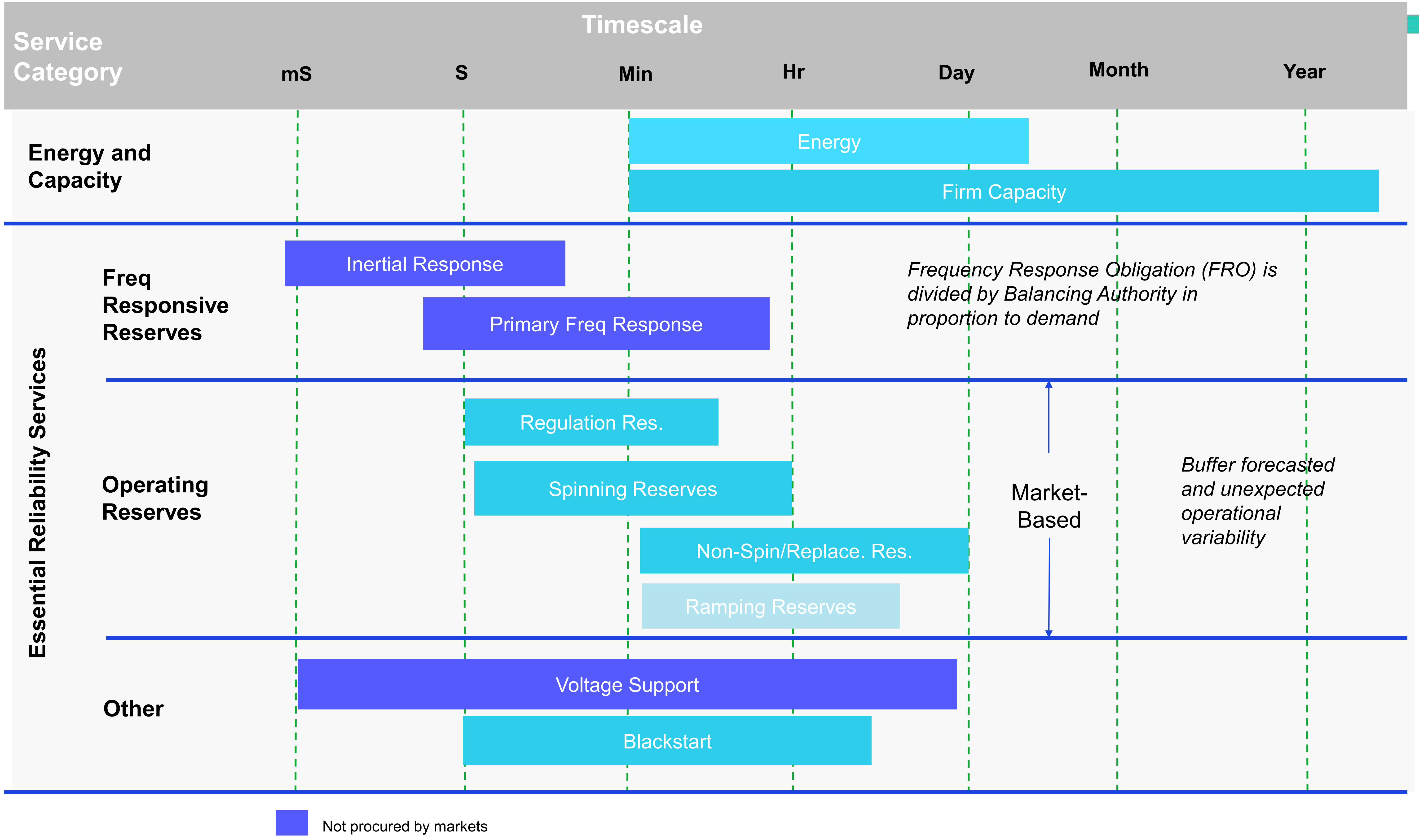



- Traditional planning methods are evolving:
  - Resource Adequacy: Effective Load Carrying Capability (ELCC)
  - Time-series transmission security (8760 hrs)
  - Probabilistic production cost simulations (renewable/load profiles)
  - Coordinated/Integrated T&D planning
  - Scenario planning approaches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



QUANTA TECHNOLOGY aes Indiana

# 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 |



QUANTA TECHNOLOGY aes Indiana

# 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 |



QUANTA TECHNOLOGY aes Indiana

# Scorecard – Portfolio Scores

| | Year 2031 | | Status Quo | Refuel | 1 Retire | 2 Retire | Clean | Optimize |
|---|---|---|---|---|---|---|---|---|
| | | | Candidate Portfolios in 2031 | | | | | |
| 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 |



QUANTA TECHNOLOGY aes Indiana

# 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**

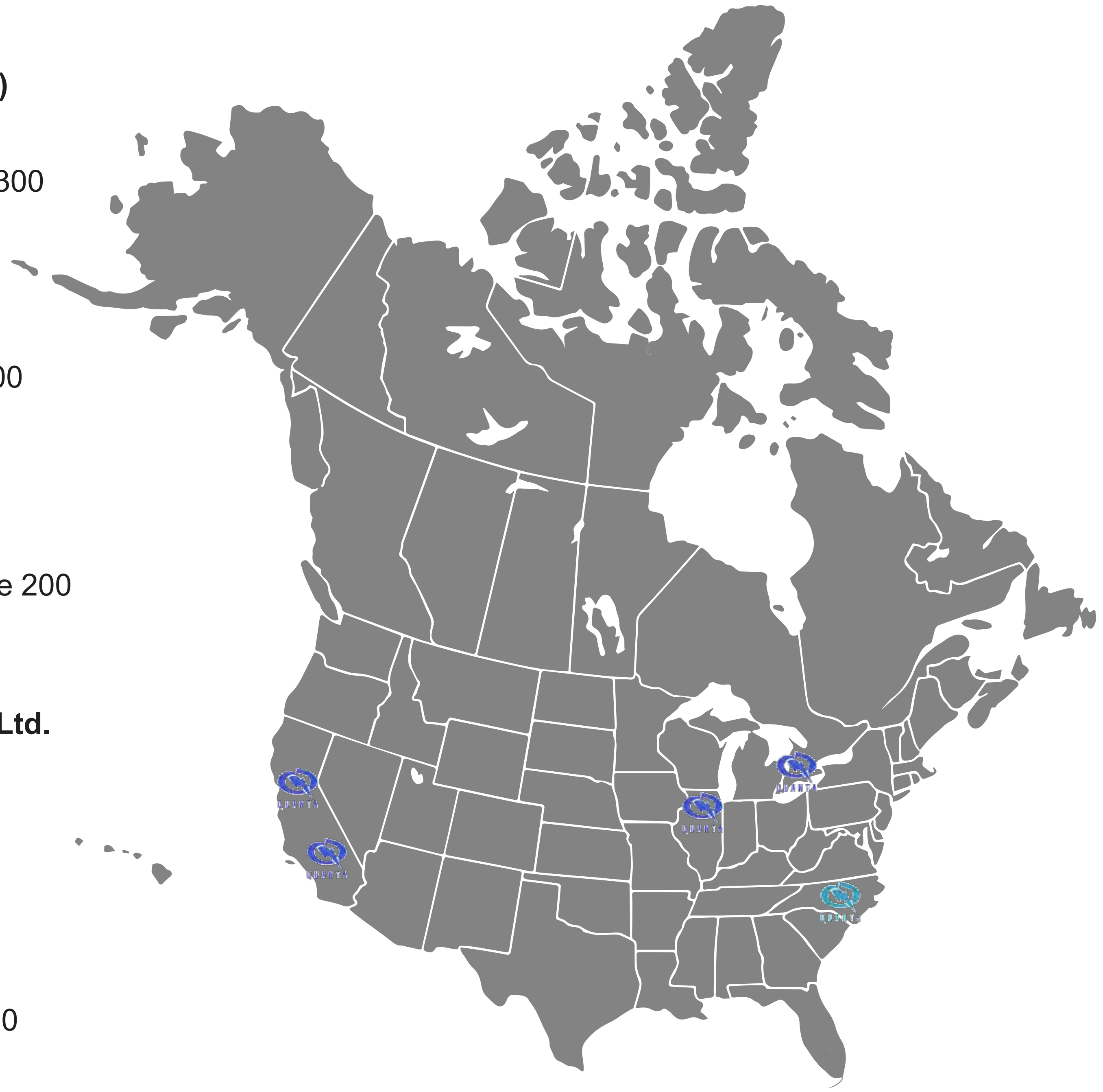
720 East Butterfield Rd., Suite 200
Lombard, IL  60148

**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

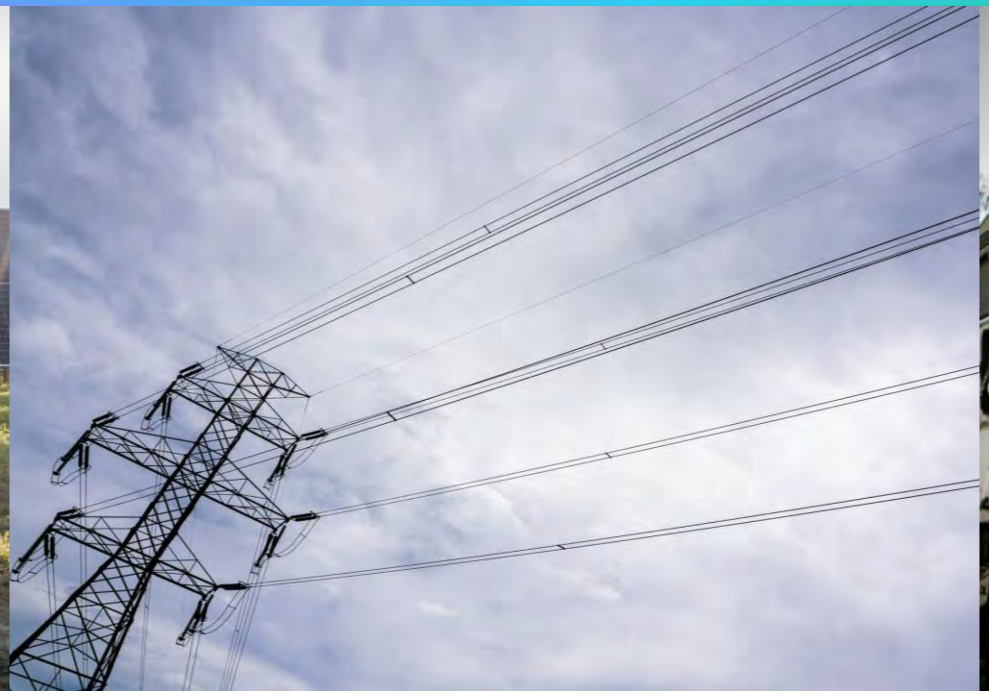
| | Affordability | Environmental Sustainability | | | | | | Reliability, Stability & Resiliency | Risk & Opportunity | | | | | | | Economic Impact | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *20-yr PVRR* | *$CO_2$ Emissions* | *$SO_2$ Emissions* | *$NO_X$ Emissions* | *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

# 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

**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

Short-Term Action Plan

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

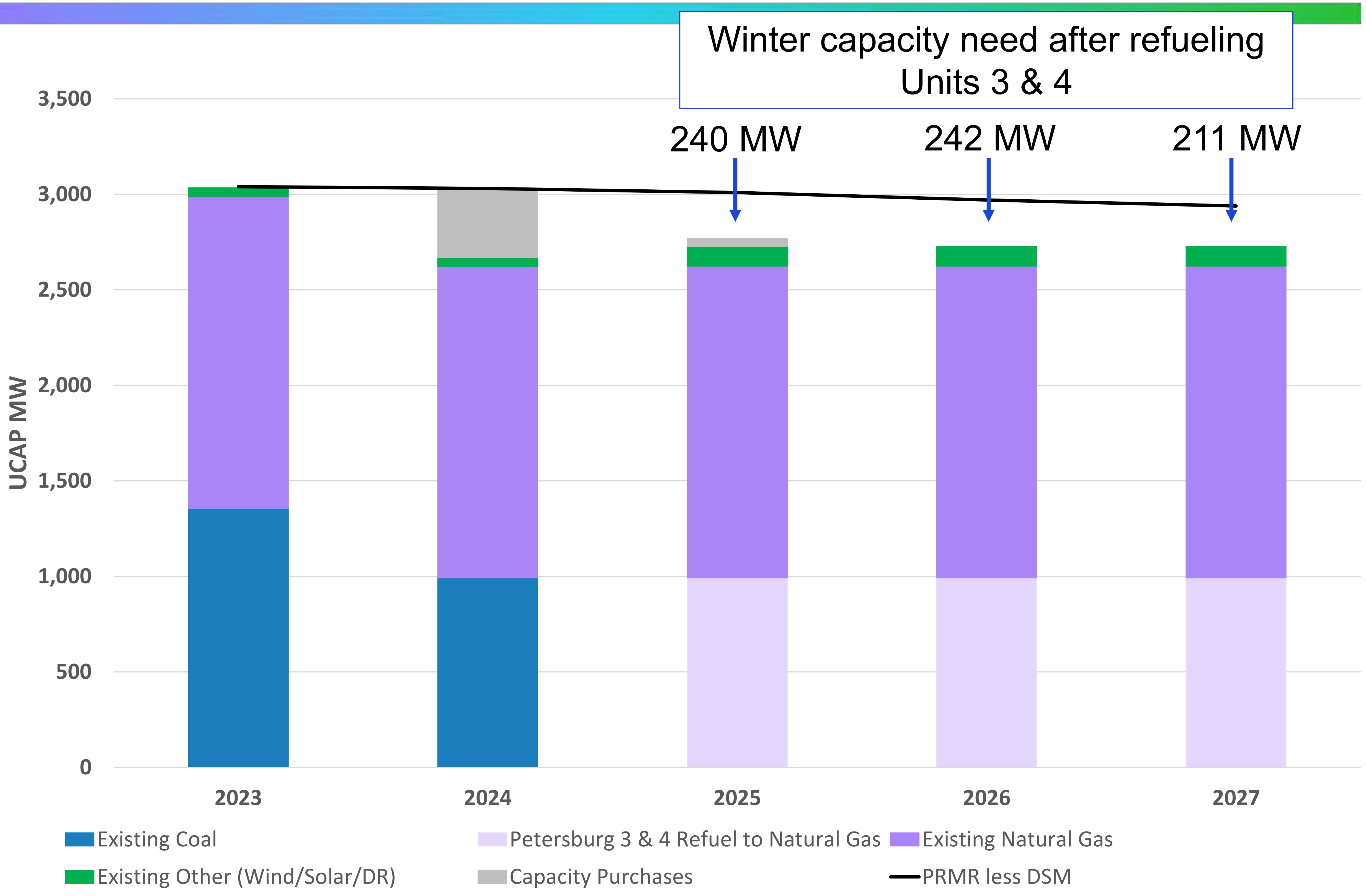


aes Indiana

# 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.






AES Indiana

# 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.**


aes Indiana

# DSM Short Term Action Plan

## DSM Results

### *Energy Efficiency:*

| | Vintage 1<br>2024 - 2026 | Vintage 2<br>2027 – 2029 | Vintage 3<br>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***

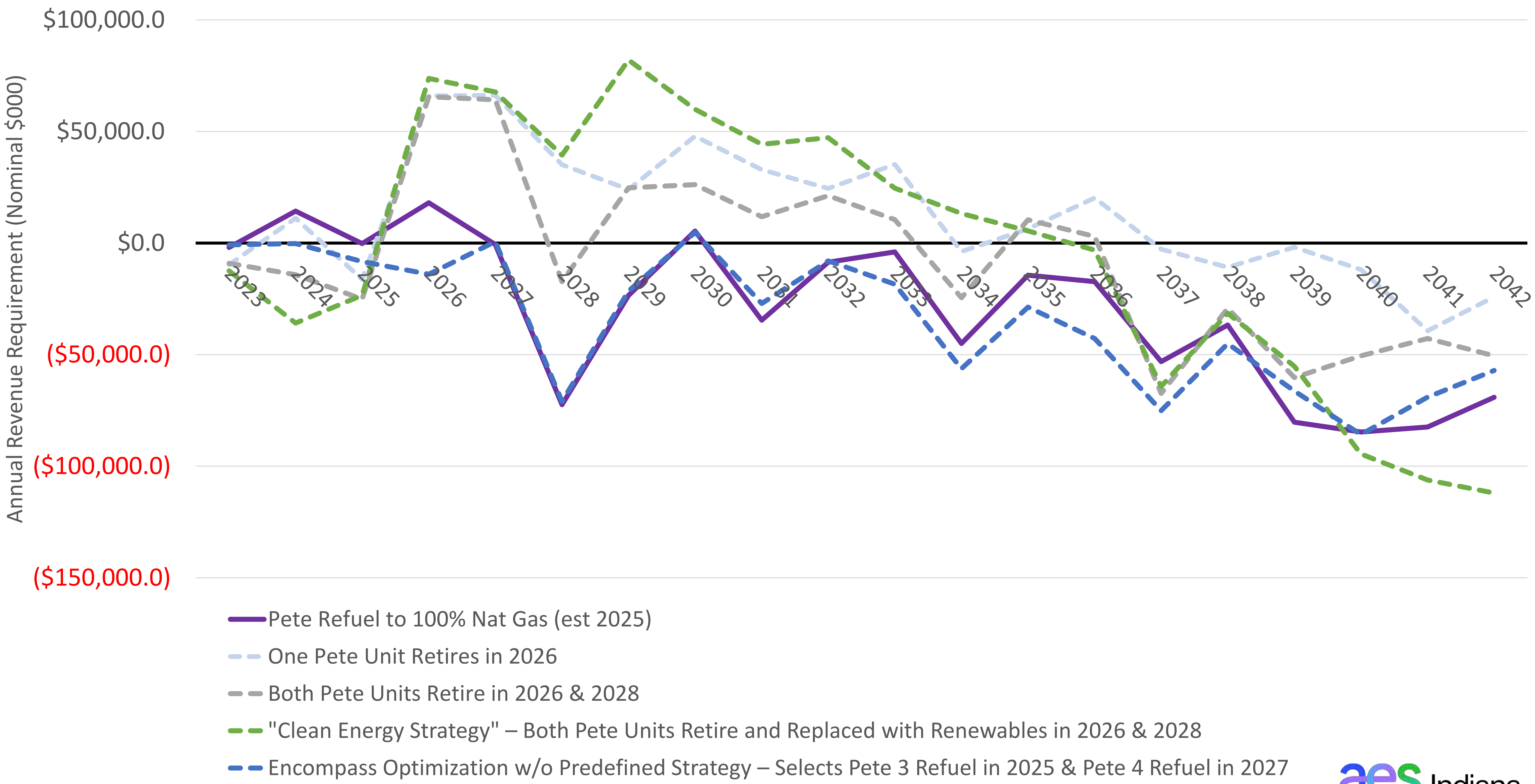
## *20-yr PVRR*

| | 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

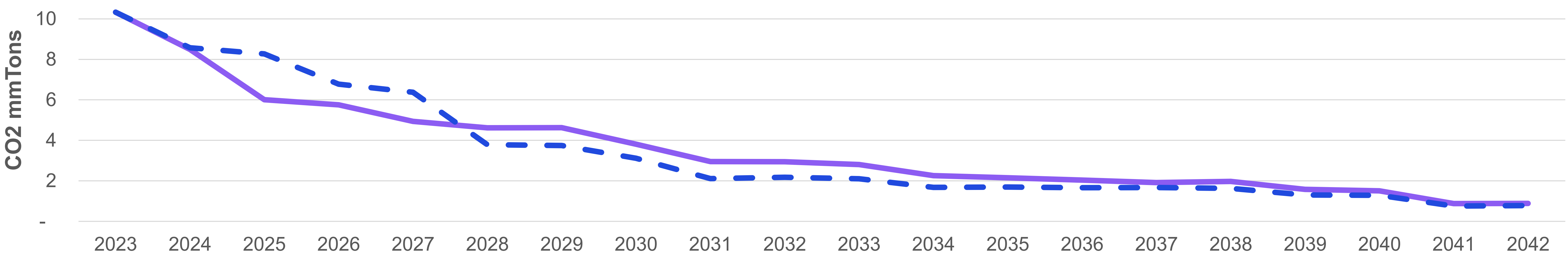
## *Compared to the No Retirement ("Status Quo") Scenario*



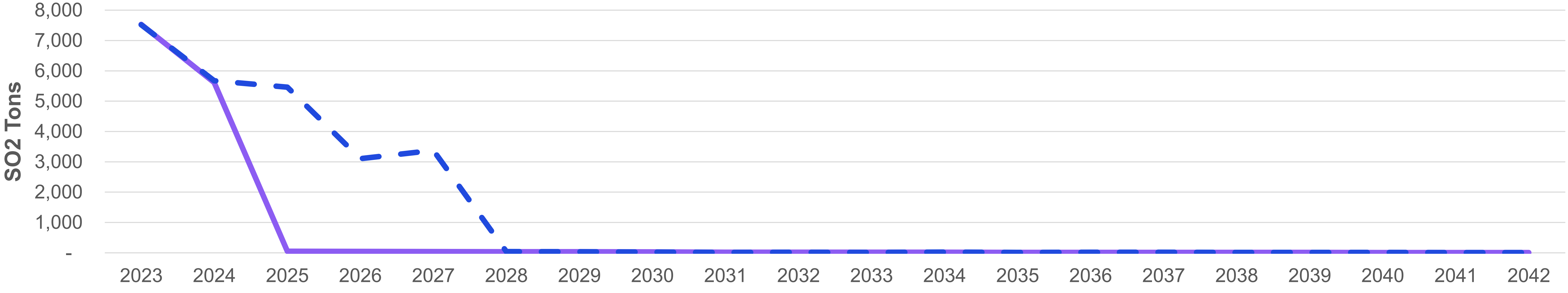
# Sustainability

***Emissions Comparison – Petersburg Conversion vs Clean Energy Strategy***

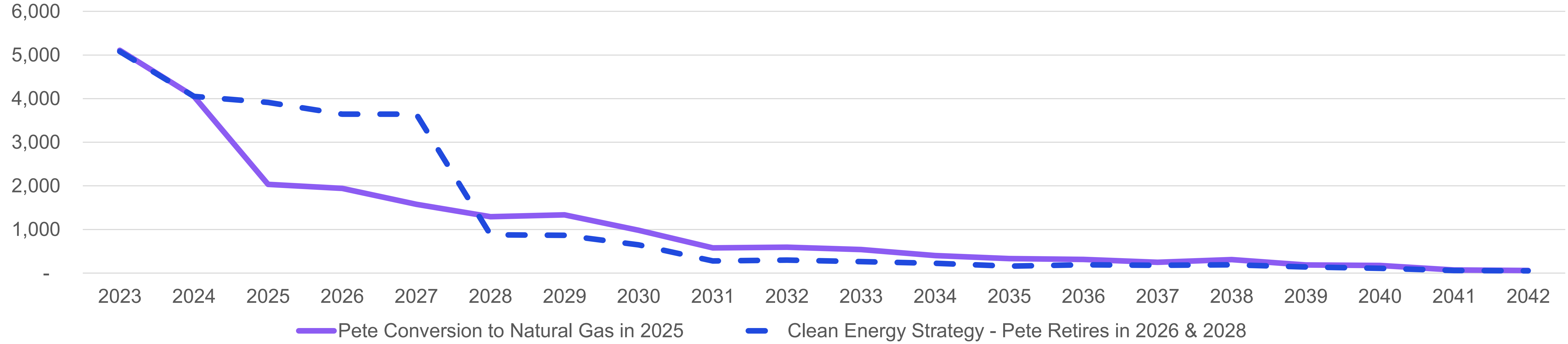
Petersburg Conversion to Natural Gas provides fastest exit from coal and as a result comparatively low emissions




| 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 |

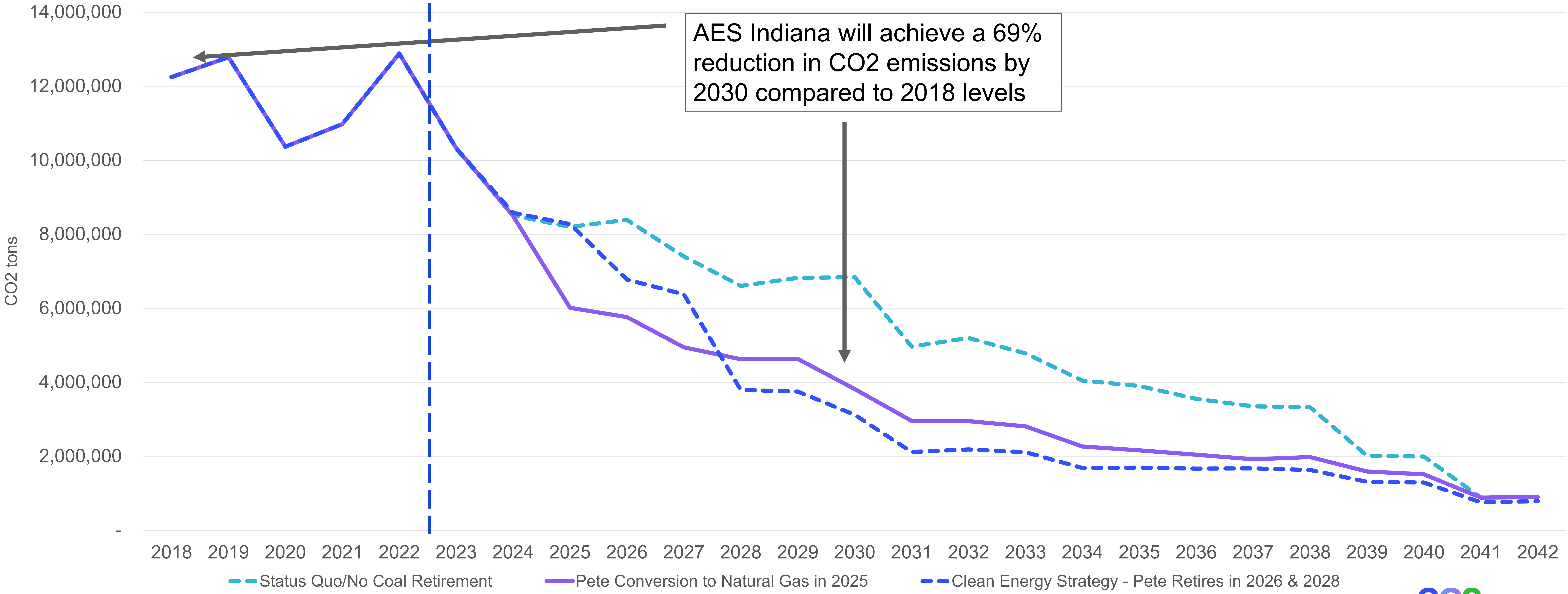



| NOx Tons | 2023 - 2032 | 2023 - 2042 |
|---|---|---|
| Pete Conversion | 19,501 | 22,146 |
| Clean Energy Strategy | 23,303 | 24,881 |

# 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.






aes Indiana

# 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

# 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



AES Indiana

# 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***.

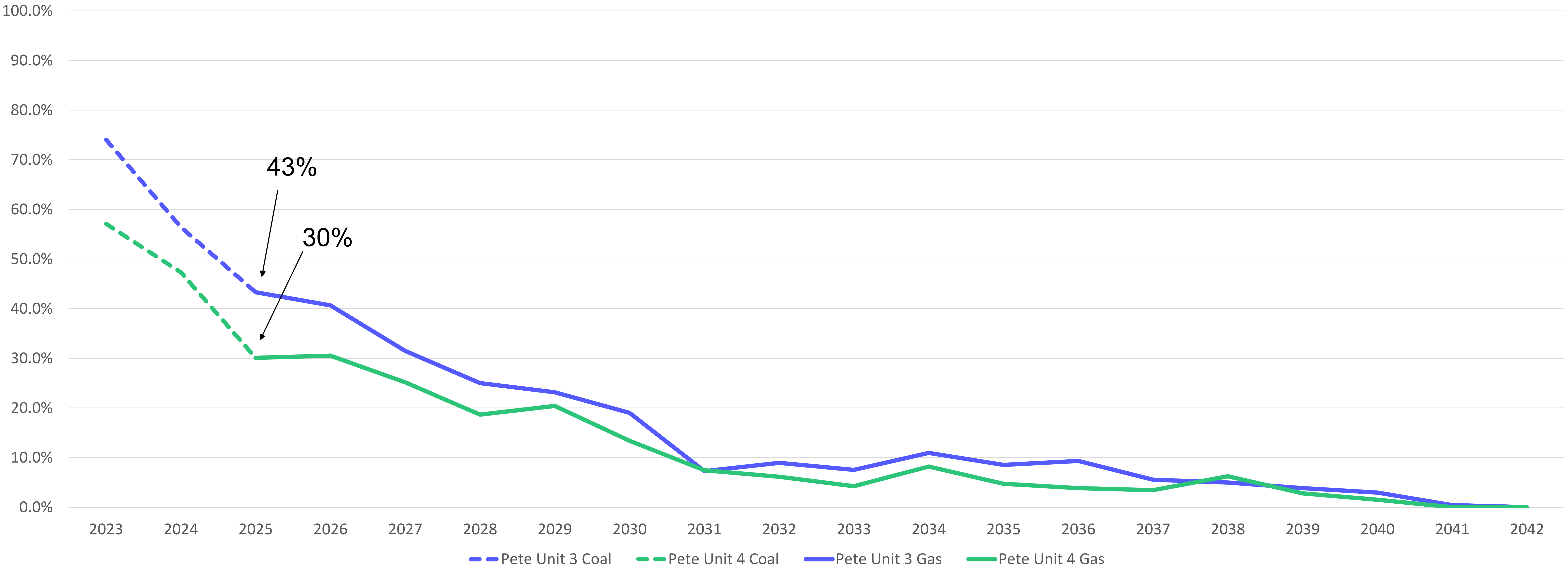
→ ***IRP Report will be filed with the IURC December 1, 2022***

# 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.



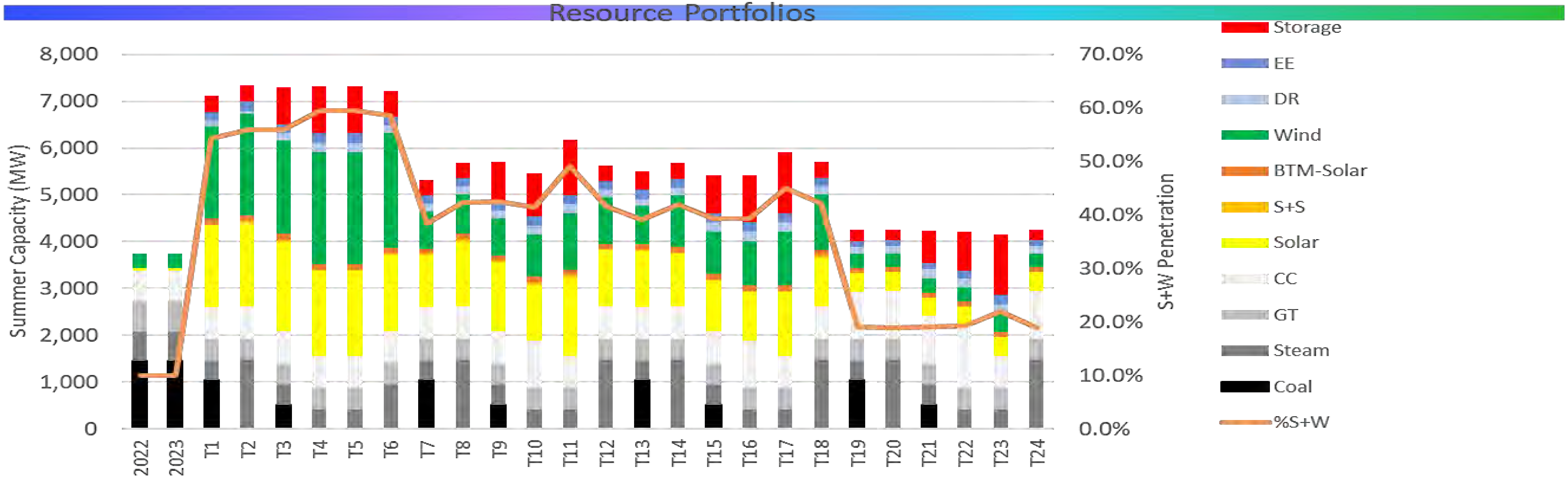


aes Indiana

# 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 |


QUANTA TECHNOLOGY
aes Indiana

# 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