aes Indiana

2022 Integrated Resource Plan

(IRP)

Volume II a

December 1, 2022

AES Indiana

2022 IRP

Attachment 1-1

(AES Indiana’s Non-Technical Summary)

aes Indiana

2022 Integrated Resource Plan
(IRP)

Non-Technical Summary

Background

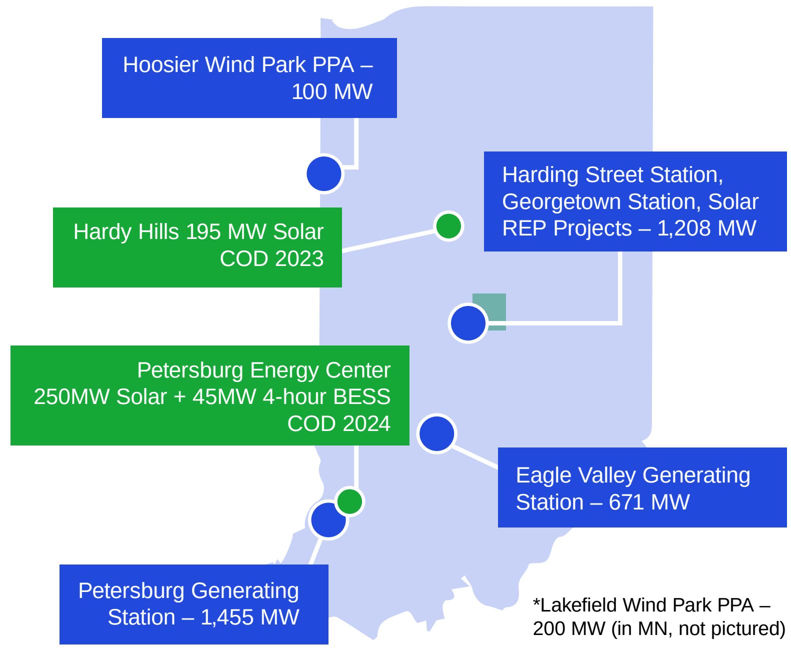
AES Indiana generates, transmits, distributes and sells electricity to approximately 517,000 retail customers in Indianapolis and neighboring areas, the most distant point being about 40 miles from Indianapolis. In total, AES Indiana's service area covers about 528 square miles.

AES Indiana is subject to the regulatory authority of the Indiana Utility Regulatory Commission ("IURC") and the Federal Energy Regulatory Commission ("FERC"). AES Indiana fully participates in the electricity markets managed by the Midcontinent Independent System Operating ("MISO"). AES Indiana is a transmission company member of Reliability First ("RF"). RF is one of eight Regional Reliability Councils under the North American Reliability Corporation ("NERC"), which has been designated as the Electric Reliability Organization under the EPAct.

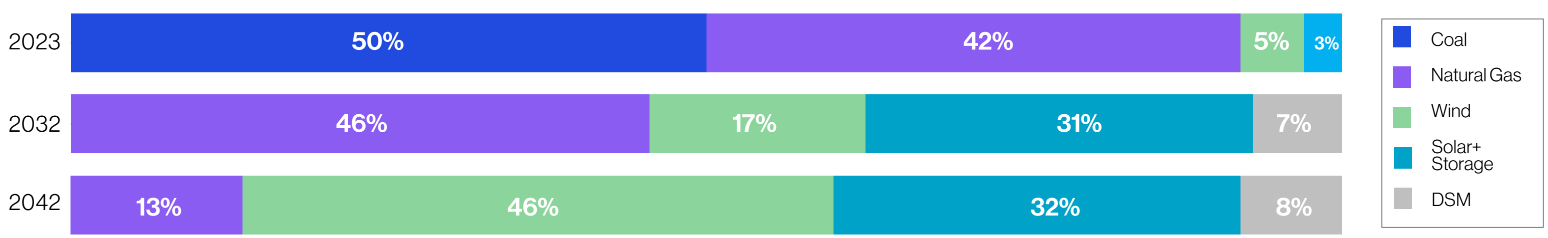
AES Indiana is part of the AES Corporation, a Fortune 500 global power company, with a mission to improve lives by accelerating the future of energy, together.

The Integrated Resource Plan ("IRP") is viewed as a guide for future resource decisions made at a snapshot in time. Resource decisions, particularly those beyond the five-year horizon, are subject to change based on future analyses and regulatory filings. Any new resource additions, including supply-side and demand-side resources, will be submitted for regulatory approval as necessary or appropriate.

3,634 Total MW of Generation



Energy mix values



Meeting Our Customers' Needs Today and Tomorrow

AES Indiana is leading the inclusive, clean energy transition.

Reliability

Affordability

Sustainability

aes Indiana

Preferred Resource Portfolio and Short Term Action Plan

AES Indiana's 2022 Integrated Resource Plan was developed in an environment with unprecedented market changes that created new challenges for long-range planning. Specifically, the approval of MISO's Seasonal Resource Adequacy Construct, the passage of the Inflation Reduction Act, volatile commodity prices for power and fuels, inflated costs for replacements resources, and scarcity within the NOx allowance market have all influenced AES Indiana's strategy and process for this IRP.

Through a transparent planning and stakeholder engagement process that addressed the noted challenges and a comprehensive evaluation of seventeen (17) Scorecard metrics, AES Indiana selected a Preferred Resource Portfolio and Short Term Action Plan that provides affordable, reliable, and sustainable energy for its customers.

AES Indiana's Preferred Resource Portfolio and Short Term Action Plan will:

1) Add Renewables

Add up to 1,300 MW of wind, solar and storage by 2027

After refueling Petersburg Units 3 and 4 to natural gas, AES Indiana still has a 240 MW winter capacity need starting in 2025 due to MISO's new Seasonal Resource Adequacy Construct. Modeling results indicate that, after including the ITC benefits for standalone storage that were included in the Inflation Reduction Act provisions, battery energy storage is the most cost-effective capacity resource to fill this need. Additionally, the model indicated that an additional 500 to 1,065 MW of wind and solar resources are needed to cost effectively replace some of the energy value provided by Petersburg as a coal resource.

2) Convert

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

Based on extensive modeling, AES Indiana has determined that the conversion of the Company's remaining coal units from coal to natural gas provides customers with a strategy that can reliably meet capacity obligations in MISO Seasonal Resource Adequacy Construct. Additionally, converting these units provides customers economic savings.

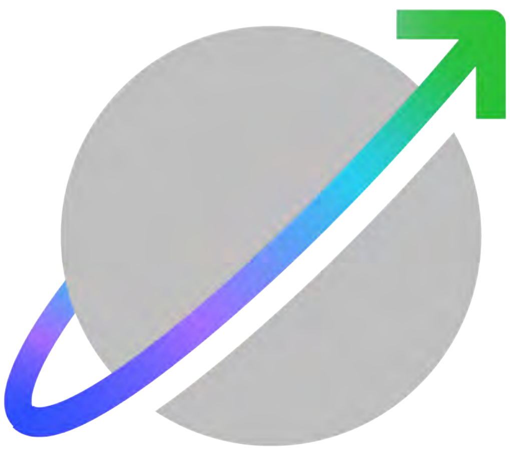
3) Monitor

Monitor emerging technologies for inclusion in future planning

Beyond the three to five-year Short Term Action Plan which includes the items mentioned above, AES Indiana intends to closely monitor new and emerging technologies that could serve as viable clean energy options for future IRP planning. More specifically, the Company is closely following progress made in new technologies like longer duration storage coupled with solar, clean hydrogen and small modular reactors that could serve as reliable capacity in future years. If these technologies are deemed cost effective and viable, the Company will include them as replacement options in future Integrated Resource Plans.

Note: Additionally, the plan includes a three-year DSM action plan that targets an annual average of 130,000 to 134,000 MWh of energy efficiency (approximately 1.1% of 2021 sales) and three-year total of 53 MW summer peak impacts of demand response.

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

aes Indiana

IRP Objective

The objective of AES Indiana's IRP is to identify a preferred resource portfolio that provides safe, reliable, sustainable, and reasonable least cost energy service to AES Indiana customers, giving due consideration to potential risks and stakeholder input. The study period for this IRP is 2023 through 2042.

IRP Process

Every three years, AES Indiana submits an Integrated Resource Plan to the IURC in accordance with Indiana Administrative Code (IAC 170 4-7). The IRP describes expected electrical load requirements, discusses potential risks, possible future scenarios and defines a preferred resource portfolio to meet those requirements over a forward-looking 20-year study period based upon analysis of all factors. This process includes extensive collaboration with stakeholders known as a "Public Advisory" process.

Public Advisory Process

AES Indiana hosted five (5) public advisory meetings and five (5) technical meetings to discuss the IRP process with interested parties and solicit feedback from stakeholders. The meeting agendas from each meeting are highlighted here.

For all meeting notes, presentations and other materials, see AES Indiana's IRP webpage at aesindiana.com/irp. AES Indiana incorporated feedback from stakeholders to shape the scenarios, develop metrics, and clarify the data presented.

Stakeholder and public input process

Public advisory meetings were held virtually via Microsoft Teams and attended by stakeholders, AES Indiana employees and members of the public.

Public Advisory Meeting #1
January 24, 2021

Topics covered: 2019 IRP recap, 2022 IRP planning and model overview, overview of existing resources, baseline energy and load forecast, electric vehicle and solar PV forecasts, introduction to demand-side management market potential study.

Public Advisory Meeting #2
April 12, 2021

Topics covered: load scenarios, market potential study results and demand-side management resources, replacement resource assumptions, scenario framework and portfolio matrix.

Public Advisory Meeting #3
June 27, 2021

Topics covered: stakeholder presentations, 2022 All-Source RFP and replacement resource cost update, commodity forecasts, RTO reliability planning, modeling reliability assumptions, reliability analysis, portfolio metrics and scorecard, distribution system planning.

Public Advisory Meeting #4
September 19, 2021

Topics covered: preliminary model results, risk analysis, preliminary scorecard results.

Public Advisory Meeting #5
October 31, 2021

Topics covered: Summary of 2022 short term action plan, analysis of preferred resource portfolio and alternatives.

aes Indiana

2022 IRP Framework

AES Indiana utilized a portfolio matrix scenario framework that evaluated five predefined strategies and one optimization (allowed the planning model to economically select a portfolio without a strategy predefined).

The five predefined strategies included:

1 Operating the remaining Petersburg Generating Station (Petersburg) coal units 3 and 4 on coal through the remainder of its useful life

2 Converting Petersburg units 3 and 4 to natural gas in 2025

3 Retiring Petersburg Unit 3 in 2026 and leaving Petersburg Unit 4 on coal through the remainder of its useful life

4 Retiring both Petersburg Units 3 and 4 in 2026 and 2028

5 Retiring both Petersburg units 3 and 4 in 2026 and 2028 and replacing them with wind solar and storage

These five strategies and sixth optimization were optimized across four different scenarios that included a range of environmental policy assumptions:

1 No Environmental Action – included relaxed environmental regulation and no subsidies for renewables

2 Current Trends/Reference Case – included the most likely future environmental regulations including renewable subsidies contained in the Inflation Reduction Act

3 Aggressive Environmental – included a carbon tax starting in 2028 at $19.47/ton

4 Decarbonized Economy – included a Renewable Portfolio Standard that requires utilities to transition supplying most of the energy from clean energy sources by 2042

Portfolio matrix

Results from the scenario analysis show that converting Petersburg to natural gas in 2025 is the reasonable least cost strategy for customers – particularly in the Current Trends/Reference Case scenario which provides the most likely representation of the future.

	Scenarios			
Strategies	No Environmental Action	Current Trends (Reference Case)	Aggressive Environmental	Decarbonized Economy
1: No Early Retirement	$7,111	$9,572	$11,349	$9,917
2: Petersburg Conversion (est. 2025)	$6,621	$9,330	$11,181	$9,546
3: One Petersburg Unit Retires (2026)	$7,462	$9,773	$11,470	$9,955
4: Both Petersburg Units Retire (2026 & 2028)	$7,425	$9,618	$11,145	$9,923
5: Clean Energy Strategy	$9,211	$9,711	$11,184	$9,690
6: Encompass Optimization	$6,610	$9,262	$10,994	$9,572

LEAST COST — HIGHEST COST

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

Note: Candidate Portfolios evaluated on the IRP Scorecard

aes Indiana

Scorecard Evaluation & Results Summary

AES Indiana conducted a robust Scorecard Evaluation of the Current Trends/Reference Case strategies (Candidate Portfolios) to select the Preferred Resource Portfolio and Short Term Action Plan.

In the Scorecard Evaluation, the Company evaluated the Candidate Portfolios using five categories that address critical utility planning considerations. These include the Five Pillars of Electric Service as defined by the 21st Century Energy Policy Development Task Force of Affordability, Sustainability, Reliability, Resiliency and Stability. Additionally, the Company included metric categories for Risks & Opportunities and Economic Impacts.

Strategies	Affordability	Environmental Sustainability						Reliability, Stability & Resiliency	Risk & Opportunity							Economic Impact	
	20-yr PVRR	CO2 Emissions	SO2 Emissions	NOX 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 FTEs associated with generation	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 [-$280]	$9,629 [$352]	5,136	$8,730	$9,909	88	$185

1: No Early Retirement | 2: Pete Refuel to 100% Gas (est. 2025) | 3: One Pete Unit Retires (2026) | 4: Both Pete Units Retire (2026 & 2028) | 5: Clean Energy Strategy | 6: Encompass Optimization

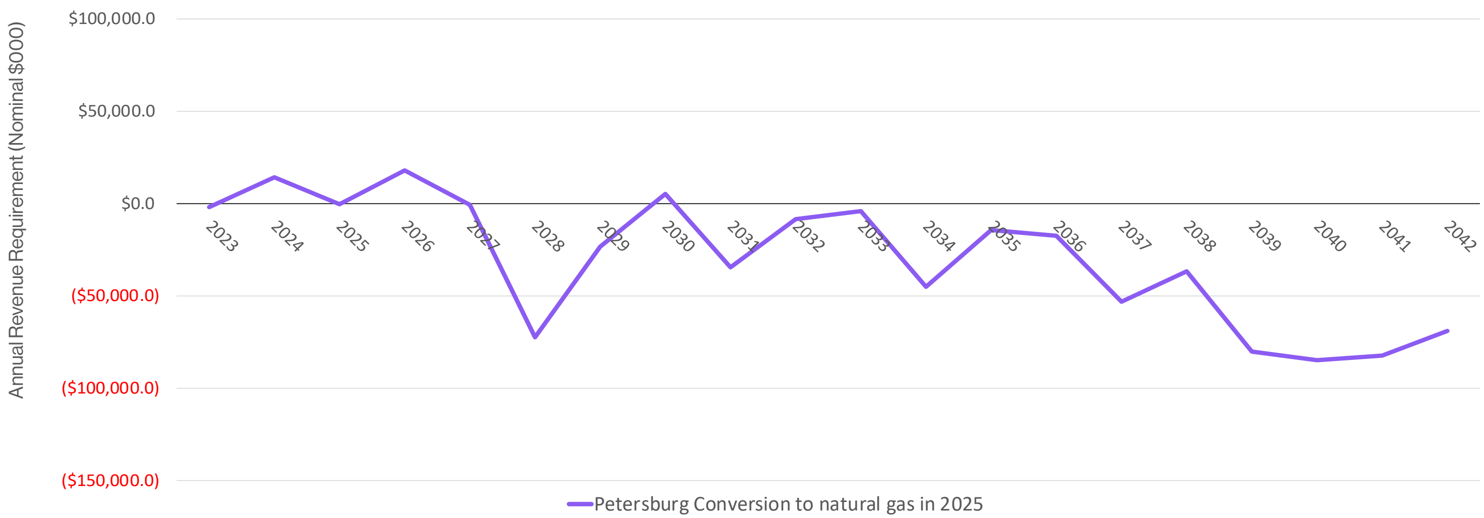
HIGHEST COST — LEAST COST

aes Indiana

Affordability

The Scorecard Evaluation demonstrated that the Petersburg conversion provides the most affordable strategy for AES Indiana customers by exhibiting the lowest 20-year Present Value of Revenue Requirements (PVRR) and lowest annual revenue requirement volatility over the 20-year planning period.

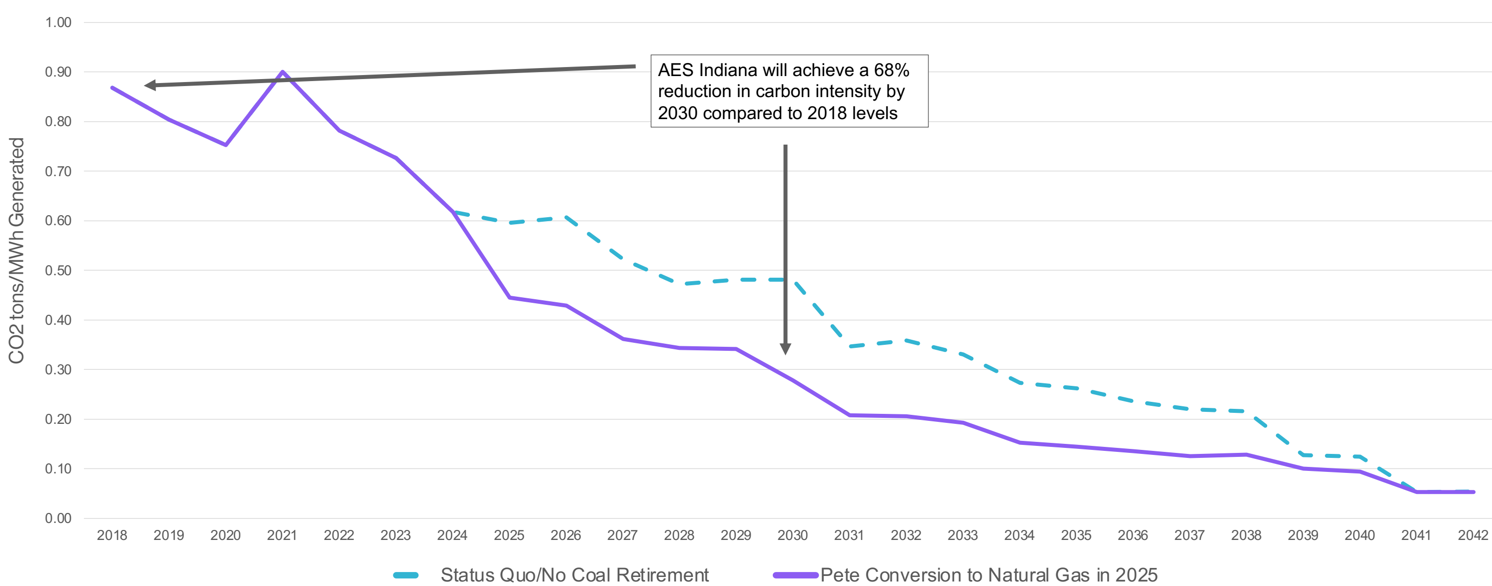
Annual revenue requirement of the Petersburg Conversion compared to the operation of Petersburg on coal from 2023-2042



Sustainability

Additionally, the Scorecard Evaluation demonstrated that the Petersburg conversion provides the lowest SO2, NOX, water use and coal production product emissions and the second lowest CO2 emissions over the 20-year planning period making it the best performing strategy in the Sustainability category. The chart at right shows that the Petersburg conversion will provide a 69% reduction in CO2 emission by 2030 compared to 2018 levels.

Carbon Intensity of the Petersburg Conversion strategy over the Planning Period (CO2/MWh)



Reliability, Resiliency and Stability

To measure Reliability in the Scorecard Evaluation, AES Indiana consulted with Quanta Technology to perform a reliability analysis of the Candidate Portfolios.

Quanta evaluated nine different reliability categories including Energy Adequacy, Operational Flexibility and Frequency Support, Short Circuit Strength Requirement, Power Quality (Flicker), Blackstart, Dynamic VAR Support, Dispatchability and Automatic Generation Control, Predictability and Firmness of Supply, and Geographic Location Relative to Load (resilience). Quanta created a Composite reliability score from these nine categories to evaluate the Candidate Portfolios.

Their analysis demonstrated that the Petersburg conversion performed the best among the Candidate Portfolios by maintaining Petersburg as a dispatchable resource.

Risk & Opportunities

The Scorecard also evaluated the Candidate Portfolios for the Risk & Opportunity associated with changing environmental policies, volatile commodities, market interaction & exposure, and fluctuating renewable resource costs. This evaluation included a stochastic analysis that ran 100 simulations of power prices, gas prices, coal prices, load, and renewable generation.

The Petersburg conversion performed the best overall across the Risk & Opportunity metrics that were considered.

Economic Impacts

Finally, the Scorecard considered the Economic Impacts from the Candidate Portfolios.

The evaluation determined that the Petersburg conversion will continue 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.

Scorecard Evaluation & Results Summary

aes Indiana

2022 Integrated Resource Plan (IRP):
Non-Technical Summary

AES Indiana
One Monument Circle, Indianapolis, Indiana 46204

aesindiana.com

AES Indiana

2022 IRP

Attachment 1-2

(AES Indiana’s Public Advisory Meeting Presentations)

2022 Integrated Resource Plan (IRP)

Public Advisory Meeting #1

1/24/2022

aes Indiana

Agenda and Introductions

Stewart Ramsay, Managing Executive, Vanry & Associates

Agenda

Time	Topic	Speakers
Morning **Starting at 10:00 AM**	Safety and Virtual Meeting Schedule and Protocols	Chad Rogers, Senior Manager, Regulatory Affairs, AES Indiana Brandi Davis-Handy, Chief Public Relations Officer, AES US Utilities
	Welcome and Overview of AES Indiana	Kristina Lund, President & CEO, AES US Utilities
	IRP Planning and Model Overview	Erik Miller, Manager, Resource Planning, AES Indiana Will Vance, Senior Analyst, AES Indiana
	2019 IRP Recap	Aaron Cooper, Chief Commercial Officer, AES US Utilities Erik Miller, Manager, Resource Planning, AES Indiana
	Overview of Existing Resources, Replacement Resource Options and Future IRPs	Aaron Cooper, Chief Commercial Officer, AES US Utilities Erik Miller, Manager, Resource Planning, AES Indiana
Break **11:45 AM – 12:15 PM**	Lunch	
Afternoon **Starting at 12:15 PM**	Baseline Energy and Load Forecast	Eric Fox, Director, Forecasting Solutions, Itron Mike Russo, Forecast Consultant, Itron
	Electric Vehicle (EV) and Solar PV Forecasts	Jordan Janflone, EV Modeling Forecasting, GDS Associates Patrick Burns, PV Modeling Lead and Regulatory/IRP Support, Brightline Group
	DSM Market Potential Study Introduction	Jeffrey Huber, Overall Project Manager and MPS Lead, GDS Associates Jacob Thomas, Market Research and End-Use Analysis Lead, GDS Associates Melissa Young, Demand Response Lead, GDS Associates
	Final Q&A and Next Steps	

aes Indiana

Virtual Meeting Protocols and Safety

Brandi Davis-Handy, Chief Public Relations Officer, AES US Utilities
Chad Rogers, Senior Manager, Regulatory Affairs, AES Indiana

IRP Team Introductions

AES Indiana Leadership Team

Aaron Cooper, Chief Commercial Officer, AES US Utilities
Brandi Davis-Handy, Chief Public Relations Officer, AES US Utilities
Kristina Lund, President & CEO, AES US Utilities
Wendy Mehringer, Chief Customer Officer, AES US Utilities
Judi Sobecki, General Counsel and Chief Regulatory Officer, AES US Utilities

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, Senior Manager, Regulatory Affairs, AES Indiana
Brent Selvidge, Engineer, AES Indiana
Will Vance, Senior Analyst, AES Indiana

AES Indiana IRP Partners

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
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

AES Indiana Legal Team

Nick Grimmer, Indiana Regulatory Counsel, AES Indiana
Teresa Morton Nyhart, Counsel, Barnes & Thornburg LLP

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, however, if you have a camera on, please refrain from distractions.

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
January 24, 2022	**March/April**	**May/June**	**July/August**	**September/October**

→ 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 Stakeholder Meeting for stakeholders with nondisclosure agreements. Tech Meeting topics will focus on those anticipated at the next Public Stakeholder Meeting.

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

AES Purpose & Values

Accelerating the future of energy, together.

Safety first

Highest standards

All together

Make your virtual environment safer

1.

Secure Your Accounts Use unique, complex passphrases and enable two-factor authentication wherever possible.

2.

Think before you click on a link, file, or attachment on your laptop and mobile.

3.

Know Your Network Protect your home network by changing default passwords; use a VPN when conducting sensitive transactions or on public WiFi.

4.

Protect your Device Patch your devices regularly and be mindful of connecting unauthorized hardware like USB drives.

5.

Share Data Responsibly Control your social media settings and be mindful when posting publicly.

6.

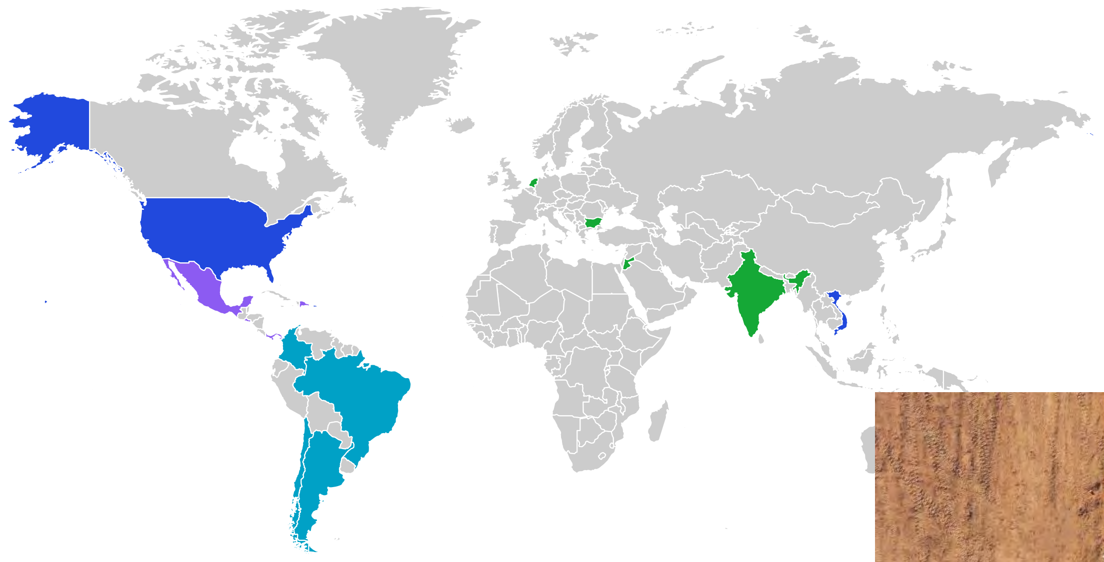
Be Safe by Being Prepared Know the cyberattack types and report anything suspicious.

aes Indiana

Welcome & Overview of AES Indiana

Kristina Lund, President & CEO, AES US Utilities

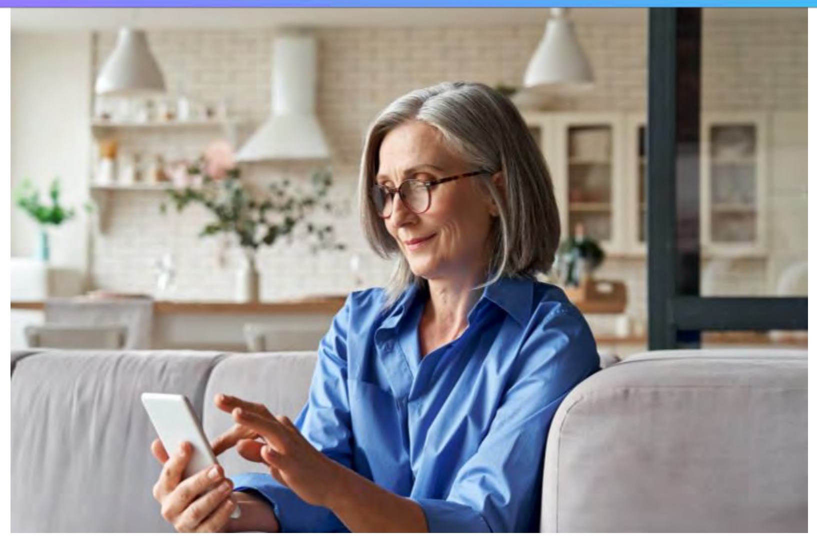
A Once in a Lifetime Transformation in the Energy Sector



AES: a unique culture of excellence, innovation and customer-centric product development.

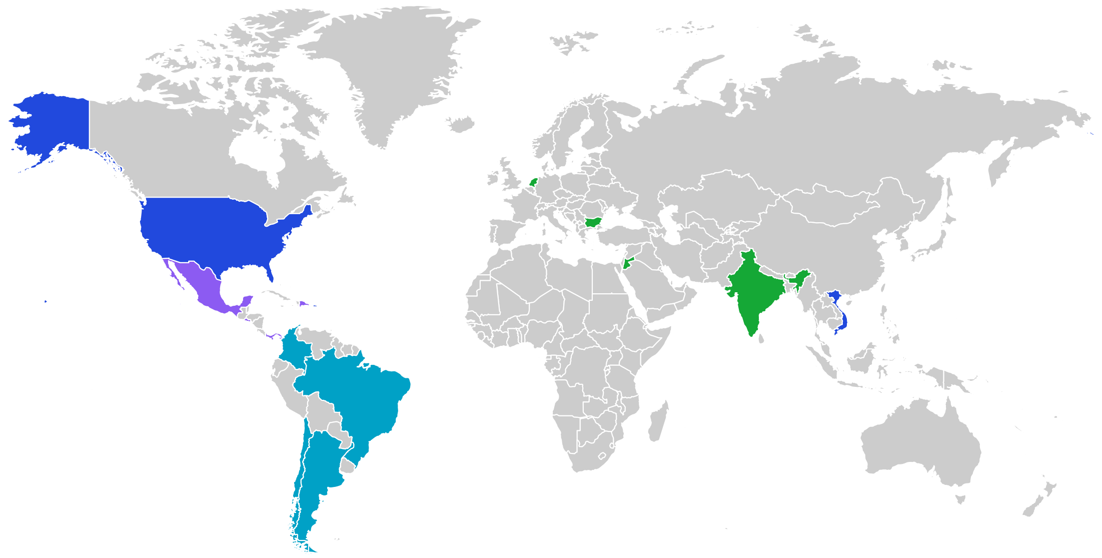
7x

Edison Award Winner



aes Indiana

Company Overview



30,308

Gross MW in operation*

$9.78 billion

Total 2020 revenues

6,909 MW

Renewable generation under construction or with signed PPAs

$34.6 billion

Total assets owned & managed

4 Continents

14 Countries

4 Market-oriented strategic business units

6 Utility companies

2.5 million

Customers served

8,200 people

Our global workforce

Recognized for our commitment to sustainability

Great Place To Work®

2021 WORLD'S MOST ETHICAL COMPANIES® WWW.ETHISPHERE.COM 8-TIME HONOREE

FTSE4Good

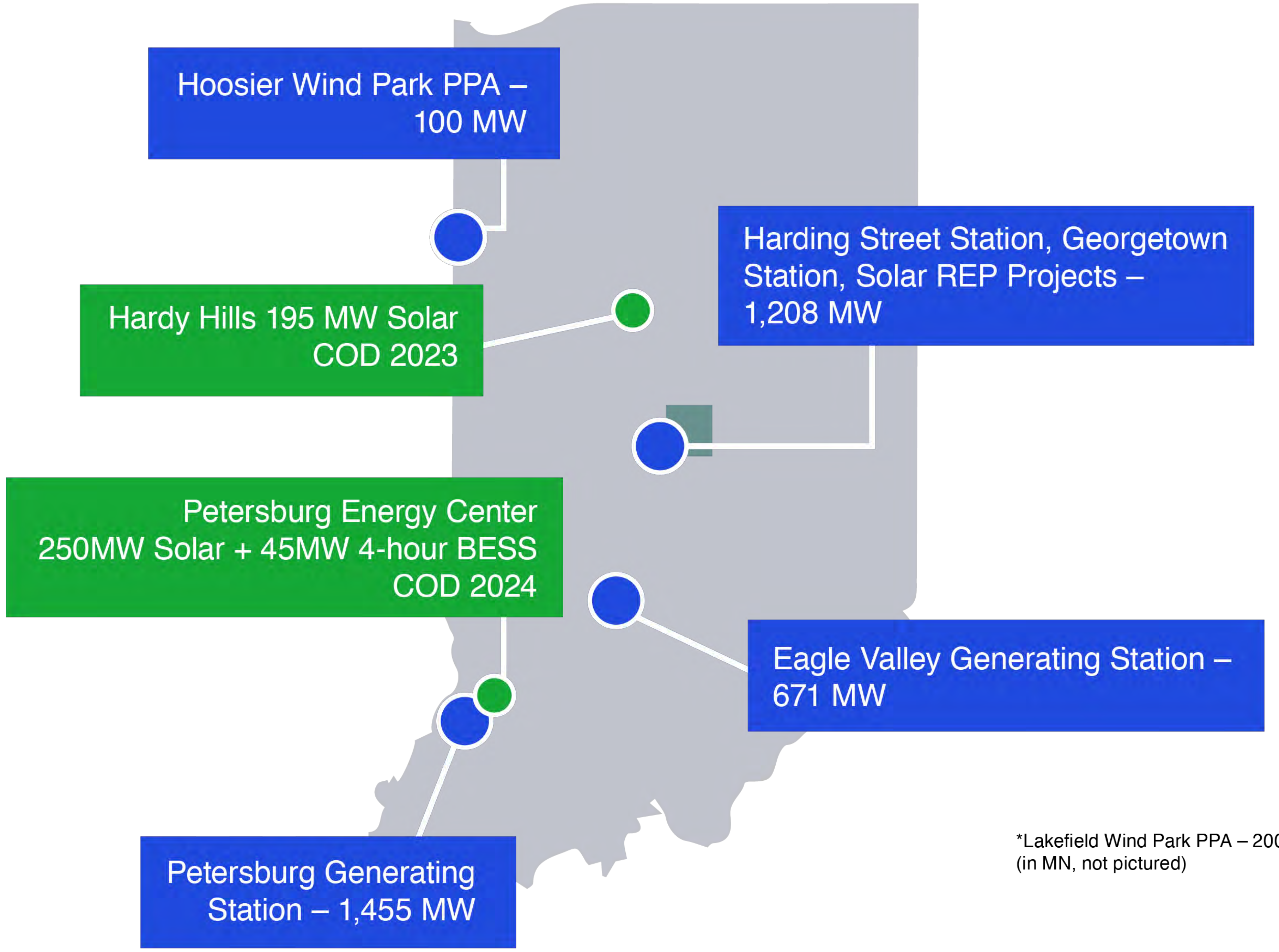
FAST COMPANY

aes Indiana

- MISO Member
- 528 square miles
- Serves downtown Indianapolis and 8 counties in Indiana
- Serves > 500,000 regulated customers
- 3,643 MW of Generation
  - 1,464 MW Coal*
  - 38 MW Oil
  - 1,745 MW Gas
  - 300 MW Wind
  - 96 MW Solar
- Retiring Pete 1 & 2 – 630 MW of coal – and replacing with solar and storage in 2023/2024

*Includes Pete 1 retirement of 220 MW

3,634 Total MW of Generation



*Lakefield Wind Park PPA – 200 MW (in MN, not pictured)

Leading the inclusive, clean energy transition

Customer	Smart Grid	Sustainability	Workforce of the Future
Reliability. Affordability. Diverse needs. **Create value in how we serve customers today to become their energy partner in the future.**	**Use new technologies across our value chain to create the resilient grid of the future.**	**Maintain reliability and affordability while driving lower carbon emissions.**	**Work differently, using new technologies and skills. Strengthen our culture of safety, innovation and belonging.**

Facilitate economic and community development

aes Indiana

IRP & Planning Model Overview

Erik Miller, Manager, Resource Planning, AES Indiana
Will Vance, Senior Analyst, AES Indiana

What is an Integrated Resource Plan?

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

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

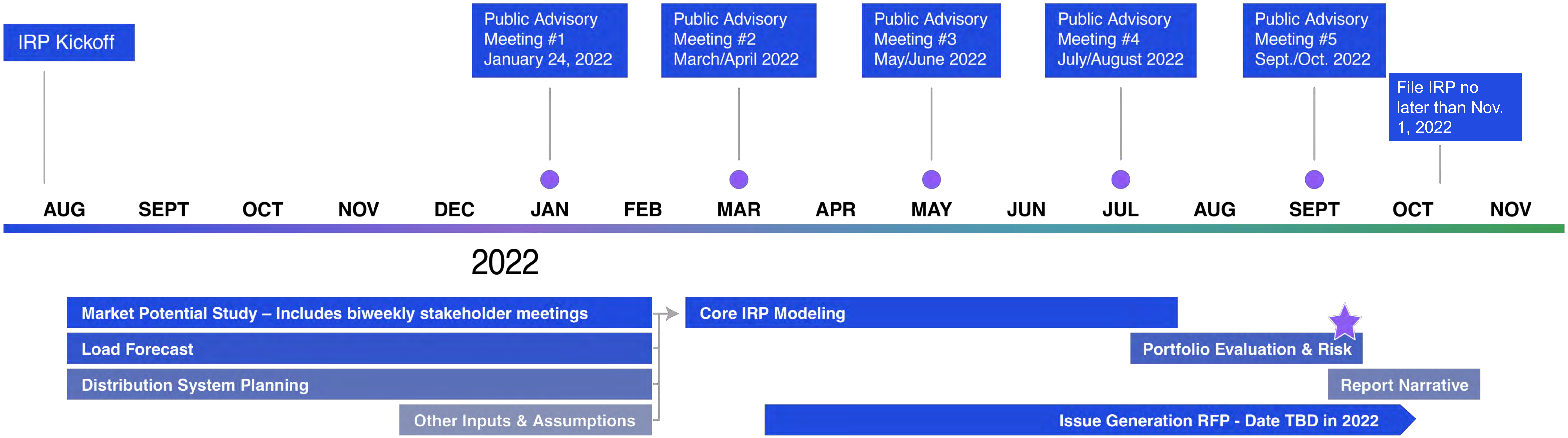
Stakeholders are critical to the process

AES Indiana is 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
- → Planning documents and modeling materials will be shared with stakeholders with NDAs upon request
- → After full consideration of stakeholder input, the Preferred Resource Portfolio will be announced in the fall of 2022

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

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.

aes Indiana

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 - March/April

- DSM Modeling & Inputs
- Replacement Resource Inputs
- Commodity Inputs

Public Advisory Meeting #3- May/June

- Portfolio Matrix Framework
- Portfolio Metrics & Scorecard Framework
- Reliability Analysis

Public Advisory Meeting #4 - July/August

- Preliminary Modeling
- Risk Analysis
- Portfolio Metrics & Scorecard Review

Public Advisory Meeting #5 - September/October

- 2022 Modeling Insights
- Preferred Resource Portfolio & Short-Term Action Plan

Topics for meetings 2-5 are subject to change depending on modeling progress.

aes Indiana

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 date TBD in 2022

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

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 Submitted Nov. 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
IRP Modeling & Evaluation – Internal with ACES & Anchor Power support

Portfolio Metrics & Scorecard

Scorecard Framework in the 2019 IRP

→ Portfolio Metrics in the 2019 IRP included three key overarching categories: Cost, Environmental and Risk

→ In 2022, AES Indiana will consider additions to the scorecard, such as reliability metrics

AES Indiana

Planning Model Overview

EnCompass

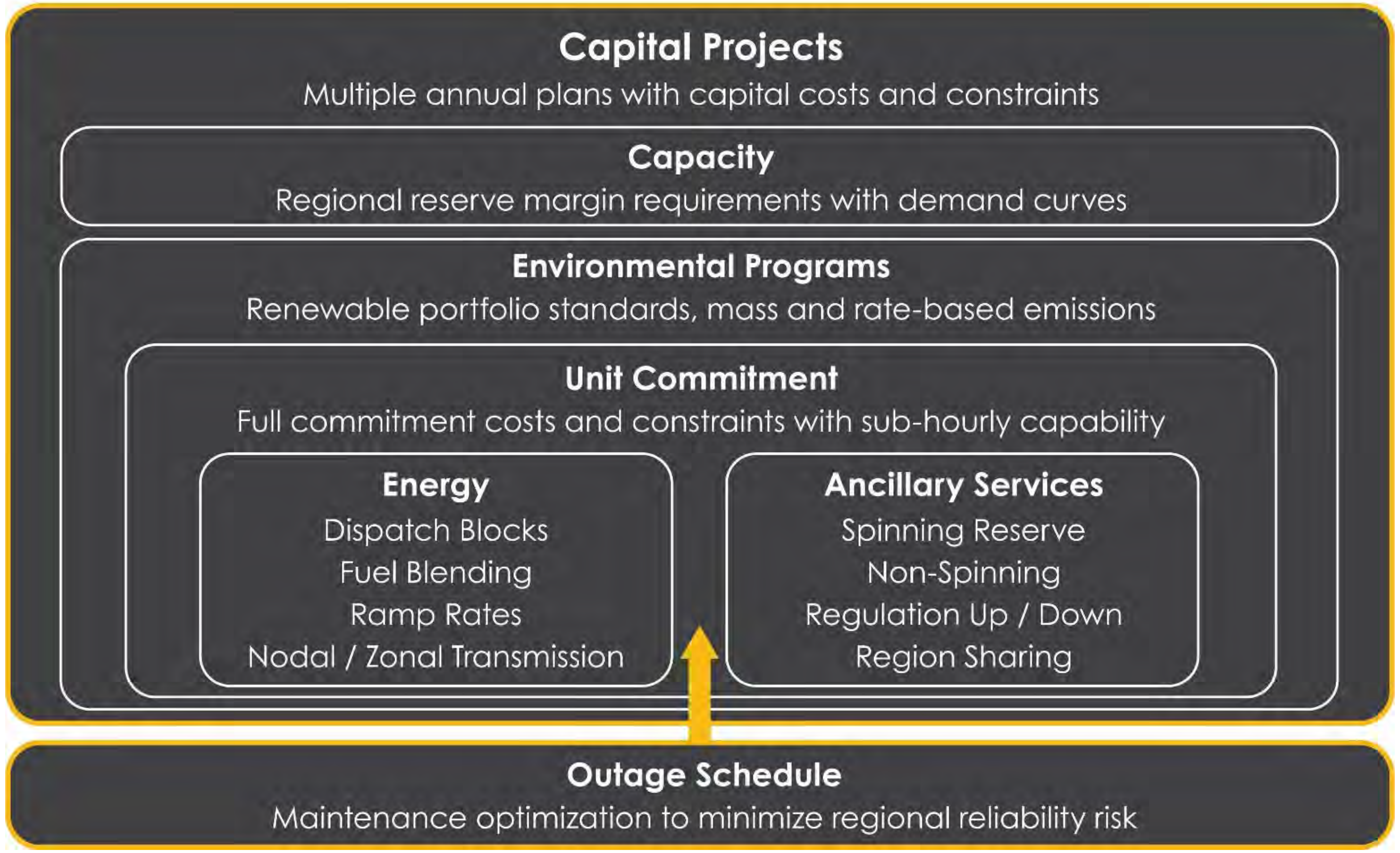
→ Long-term Production Cost and Capacity Expansion model created by Anchor Power Solutions.

→ EnCompass is used by utilities, co-ops, municipalities, and consultants. It has been used to support regulatory filings in 17 states.

EnCompass

- →EnCompass models thermal, renewable, storage, and load resources with hourly granularity.
- →It will be used for capacity expansion analysis to make long-term resource decisions based on scenario input assumptions.
- →Based on resource selections, EnCompass will calculate the present value revenue requirement of each portfolio.
- →Through the use of stochastic analysis, EnCompass will be used to understand the risk associated with portfolios.

ENCOMPASS POWER PLANNING SOFTWARE



EnCompass

Key Advantages of Utilizing EnCompass

→Quick run times

- → Allows for additional scenario analysis
- → Provides expedient model feedback

→Straightforward capacity expansion

- → Deterministic capacity expansion allows for more intuitive cause and effect results

→User control of modeling parameters

- → MIP Stop Basis is a user input for capacity expansion
- → Stochastic draws can be specified by user

→Model Transparency

- → Transparent hourly renewable and load profiles

2019 IRP Recap

Aaron Cooper, Chief Commercial Officer, AES US Utilities
Erik Miller, Manager, Resource Planning, AES Indiana

2019 IRP – Short-Term Action Plan

Retire

Retire 630 MW of coal generation by 2023:

→ Pete 1: 2021

→ Pete 2: 2023

Replace

Competitively bid for approximately 200 MW of firm capacity with all-source RFP.

Save

Target – 130,000 MWh per year of new DSM as part of the 2021-2023 DSM Plan.

Monitor

Maintain cost-effective units at Petersburg to retain flexibility and continue to monitor market conditions leading to our 2022 IRP.

Source: IPL's 2019 Integrated Resource Plan Non-Technical Summary, page 6.

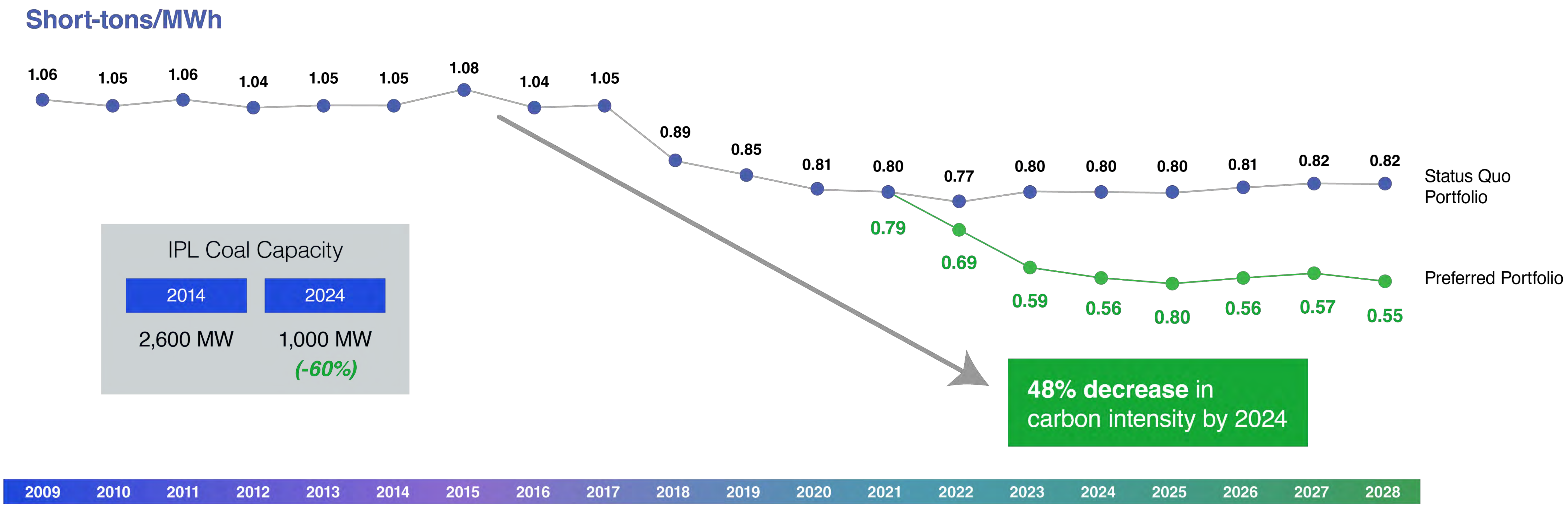
Short-Term Action Plan Progress

- **December 2019 - July 2021** – AES Indiana issues & evaluates all-source RFP for approximately 200 MW of firm capacity in 2023 that will result from the anticipated retirements of Pete Units 1 & 2.
- **November 2020** – AES Indiana receives IURC Order for the implementation of DSM programs in 2021-2023. DSM portfolio will target approximately 130,000 MWh per year.
- **May 2021** – AES Indiana retires Petersburg Unit 1 (220 MW).
- **June 2021** – AES Indiana receives IURC Order approving the CPCN for Hardy Hills Solar (195 MW) identified through the RFP process. Project estimated COD May 2023.
- **November 2021** – AES Indiana receives IURC Order approving the CPCN for the Petersburg Energy Center Solar + Storage project (250 MW solar; 45 MW 4-hr battery) identified through the RFP process. Project estimated COD June 2024.
- **May 31, 2023** – Plans for retirement of Petersburg Unit 2 (410 MW).

aes Indiana

Portfolio changes have reduced carbon intensity by 48% since 2015

Petersburg Unit 1 retired May 31, 2021
Petersburg Unit 2 anticipated retirement May 31, 2023



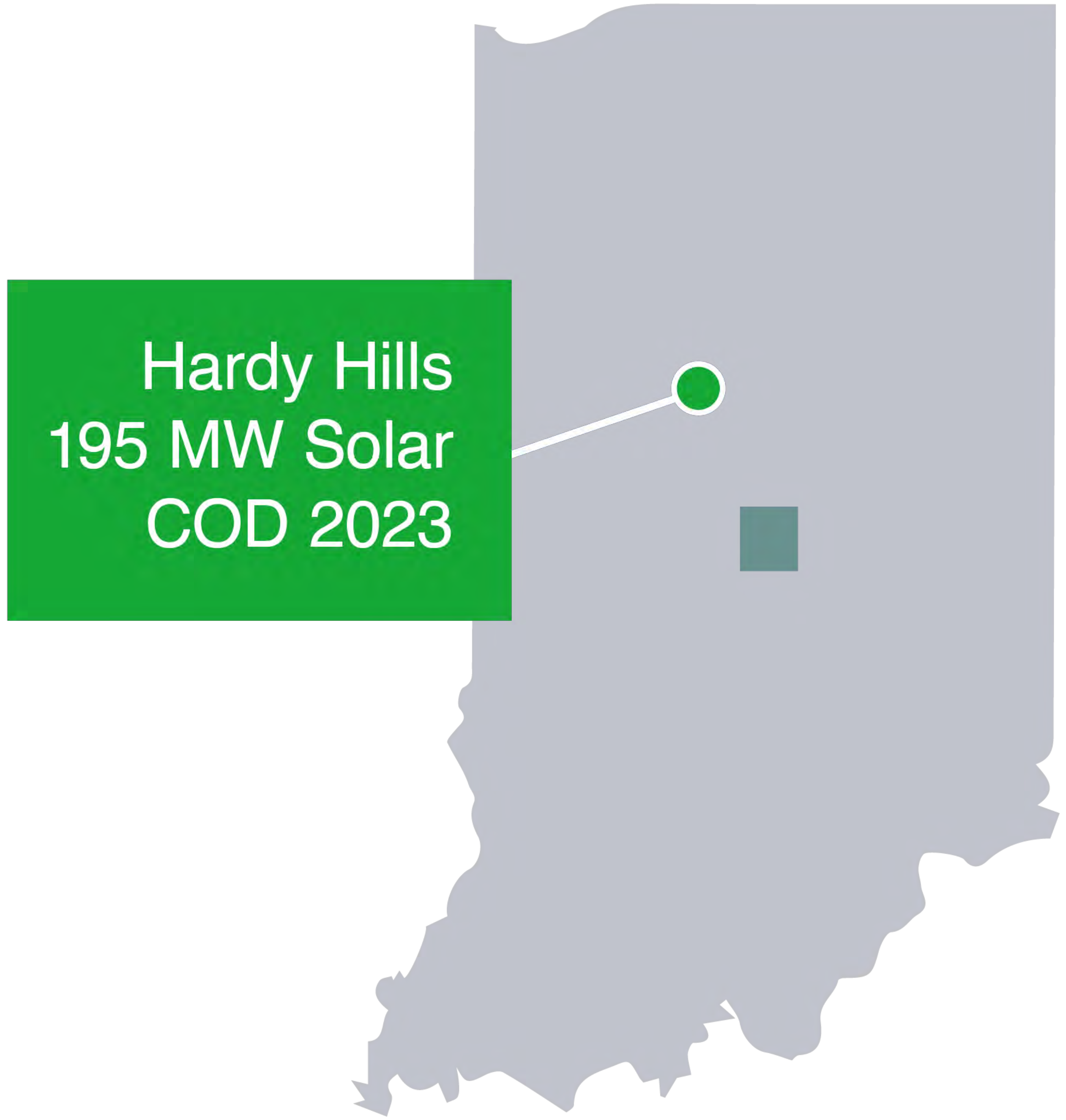
AES Indiana

Hardy Hills Solar

Project Information

- **Type:** Solar facility
- **Size:** 195 MWac ICAP
- **COD:** 2023
- **Location:** Clinton County, IN
- **Developer:** Invenergy Solar Development North America, LLC

Hardy Hills will contribute 98 MW to AES Indiana's 2023 UCAP need resulting from the retirement of Petersburg Units 1 & 2.



AES Indiana

Petersburg Energy Center

Project Information

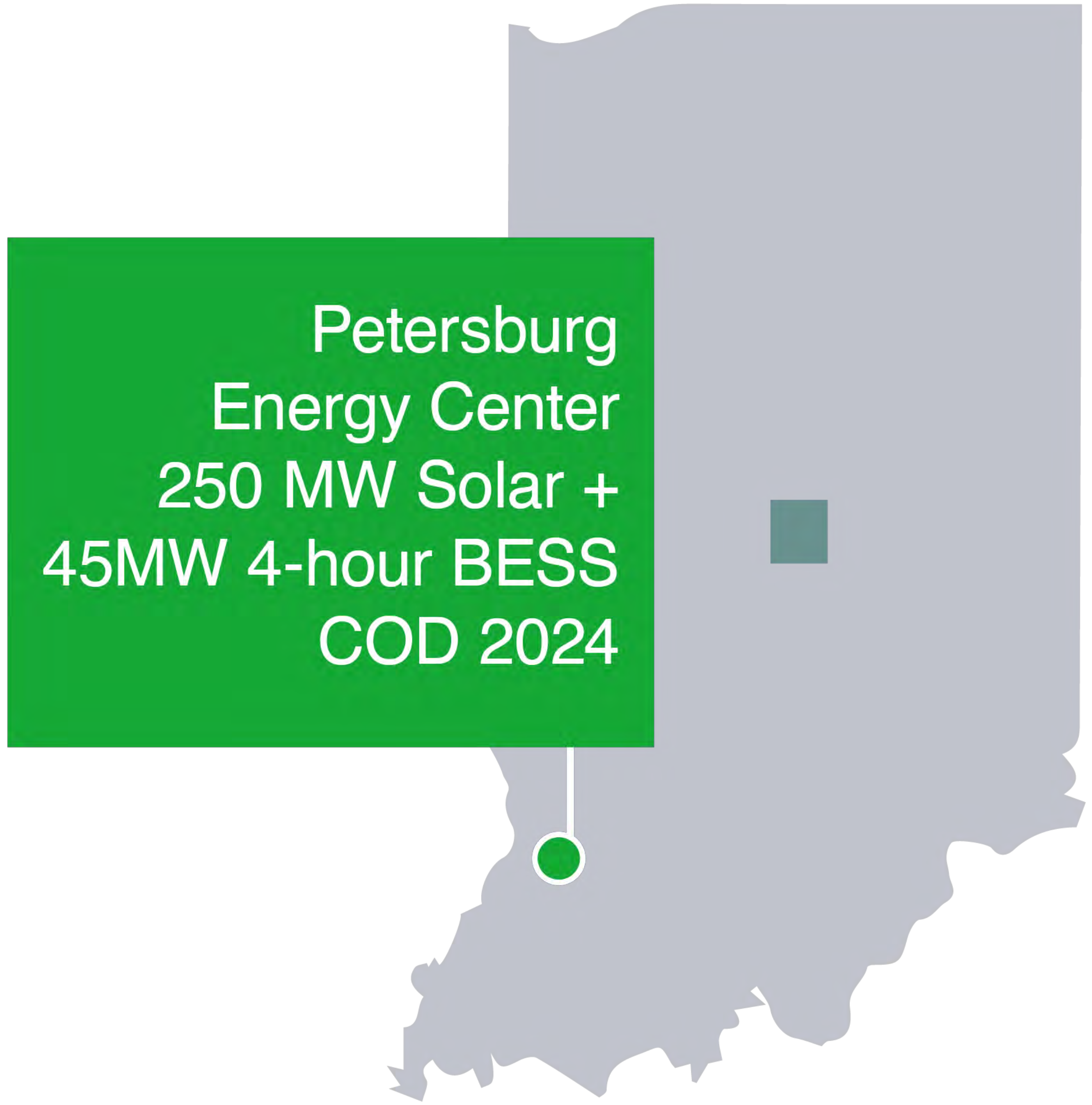
→ **Type:** Solar and battery energy storage facility

→ **Size:** 250 MWac ICAP coupled with a 180 MWh DC battery energy storage system (45 MW, 4-hour discharge power capacity)

→ **COD:** 2024

→ **Location:** Pike County, IN

→ **Developer:** NextEra Energy Resources, LLC



Petersburg Energy Center will contribute 168 MW to AES Indiana's 2023 UCAP need resulting from the retirement of Petersburg Units 1 & 2.

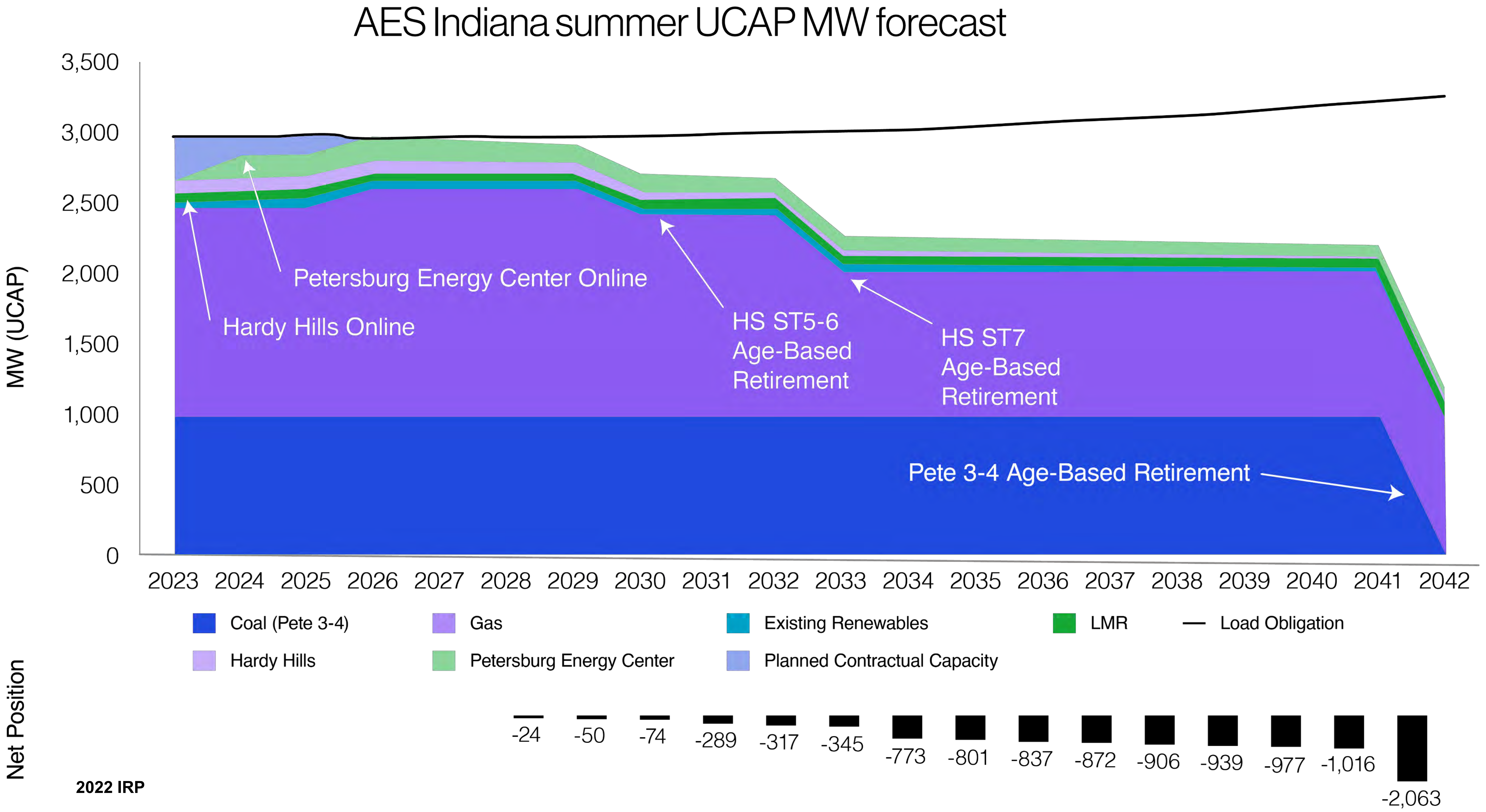
IURC Director's Comments to 2019 IRP

Topic	Comments Summary *(not exhaustive)*	2022 IRP Improvements
Resource Optimization & Risk	→ General **lack of clarity** around the model and methodology → PowerSimm's **stochastic capacity expansion methodology caused confusion** and lacked explanation → "Future IRPs would **benefit from industry experts' judgments** to evaluate whether there is a rationale for hardwiring certain resource." *– p.26, Director's Report for Indianapolis Power and Light's 2019 IRP*	→ AES IN will provide **better explanation of the model and methodology** used at stakeholder meetings and in the report. → AES IN is transitioning to **deterministic capacity expansion using Encompass** which should provide a more straightforward methodology. → An outside third-party consultant will provide **industry expert guidance** regarding resource options and modeling approaches.
DSM Modeling	→ DSM **bundles span the entire planning period** which is too long → Combining unrelated measures across residential and C&I measures makes a **questionable load shape** → Important that **hourly impact of DSM measures** be given particular attention	→ Encompass will allow for optimization using **shorter duration bundles**; AES IN will collaborate with stakeholders to determine more appropriate bundle durations. → AES IN will collaborate with our consultants and stakeholders to **consider alternative approaches** for measure bundling → AES IN will work with LBNL and NREL to **capture the hourly shapes** associated with DSM measures for inclusion in the portfolio modeling
Load Forecasting	→ IRP excluded **detailed Itron report** in the appendix → IRP excluded analysis on the **appropriateness of base temperature** for weather normalization → IRP excluded discussion of **street lighting usage** and how it is modeled in the load forecast → IRP excluded discussion of risk and uncertainty associated with the **load forecasting scenarios**	→ AES IN has contracted Itron to **perform the load forecast and provide a detailed report** that describes the methodology including all items noted to by the Director

Overview of Existing Resources

Aaron Cooper, Chief Commercial Officer, AES US Utilities
Erik Miller, Manager, Resource Planning, AES Indiana

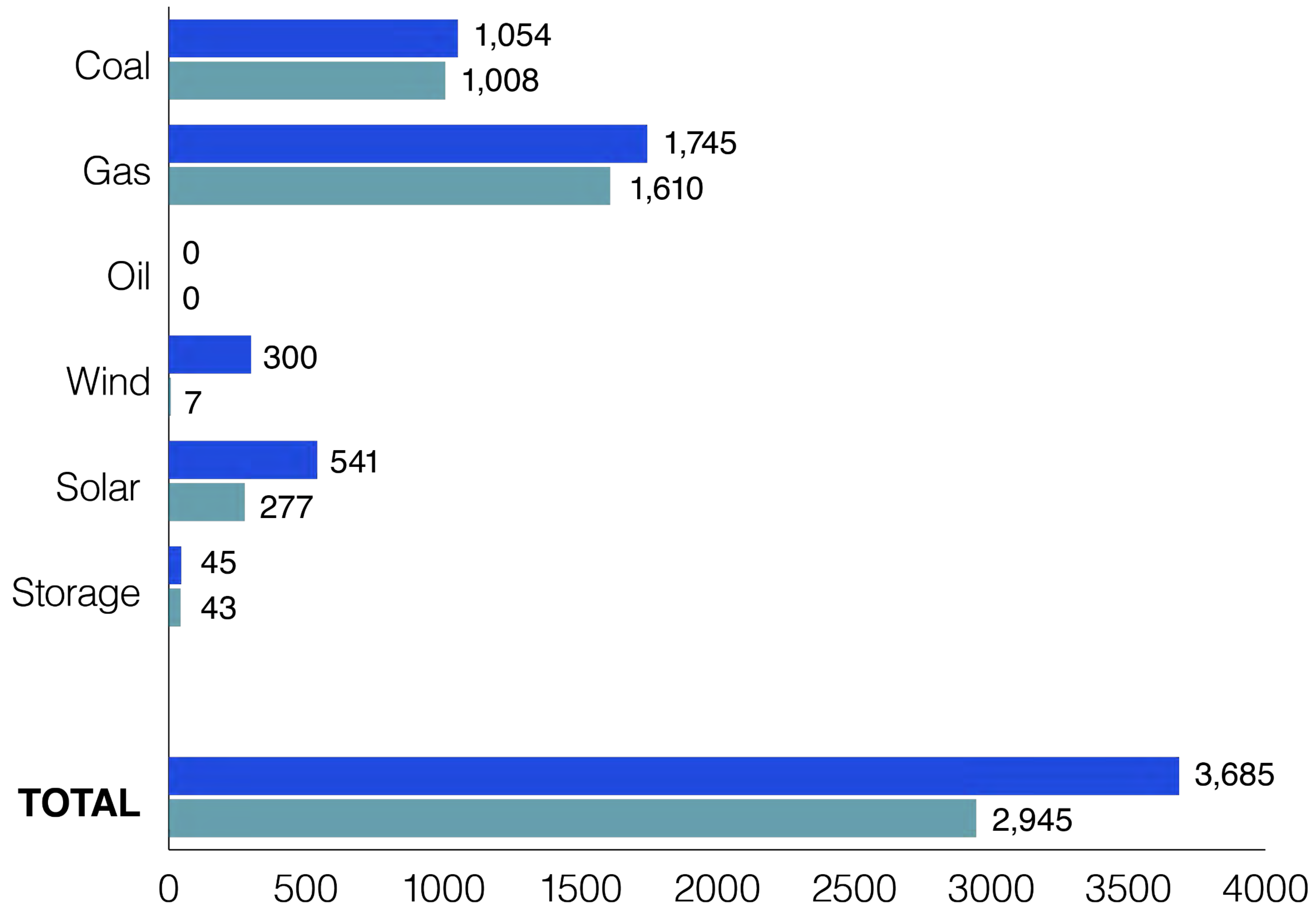
Starting Point Portfolio



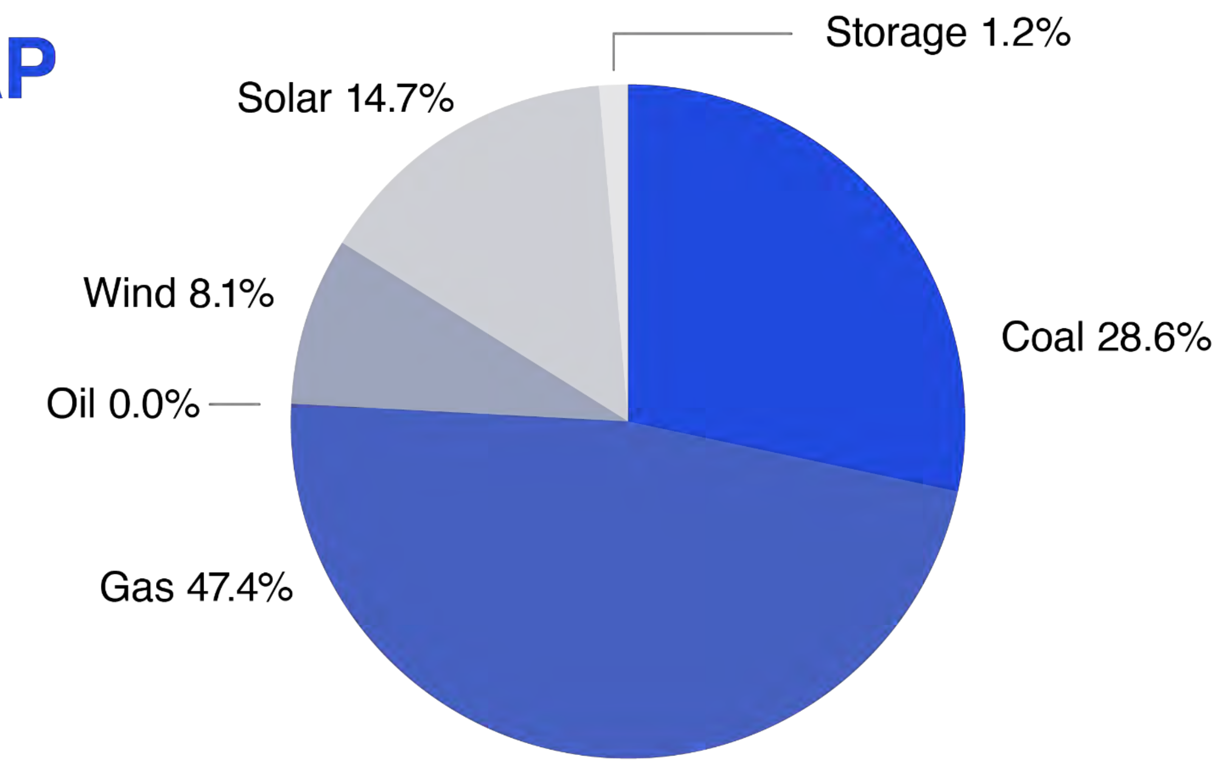
aes Indiana

AES Indiana: Current Generation Mix

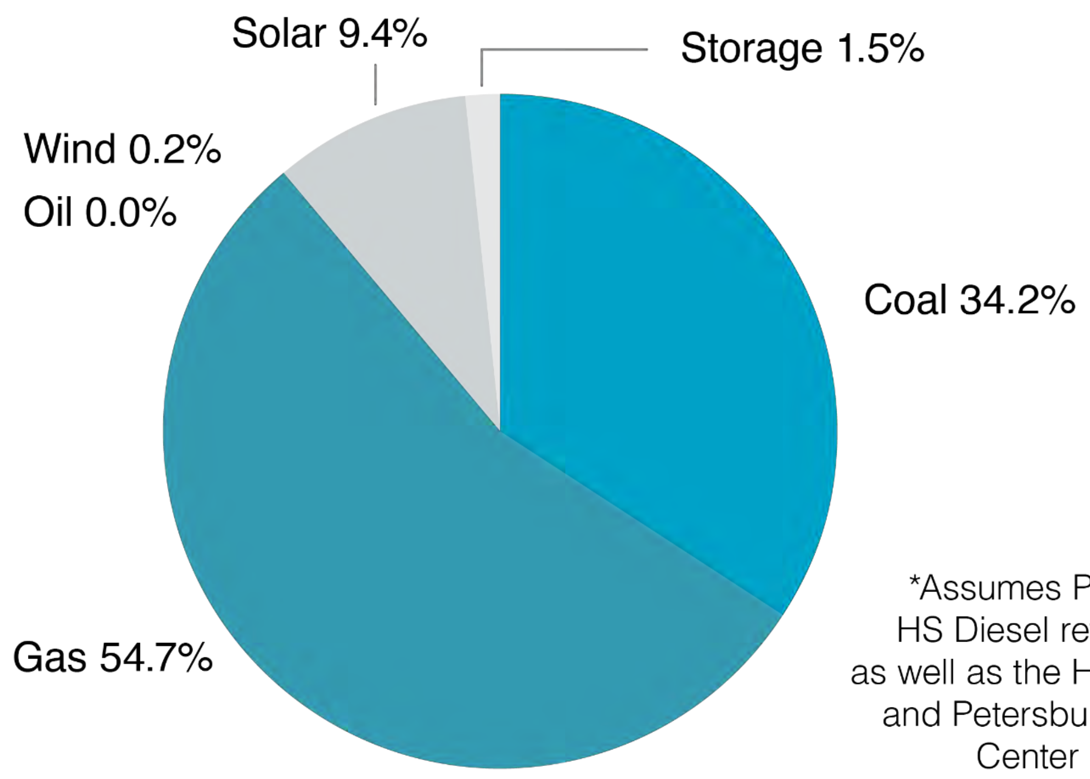
TECHNOLOGY – ICAP MW / UCAP MW



ICAP



UCAP



*Assumes Pete 2 and HS Diesel retirements, as well as the Hardy Hills and Petersburg Energy Center additions.

Existing Coal Resources

Coal Units	Reference Name	Technology	ICAP (MW)	UCAP (MW)	In-Service Year	Estimated Last Year In-Service
Petersburg						
PETE ST 2	Pete 2	Coal ST	410	368	1969	2023
PETE ST 3	Pete 3	Coal ST	518	488	1977	2042
PETE ST 4	Pete 4	Coal ST	536	520	1986	2042
		Total Coal:	1,464	1,376		

Notes on units:

- → Petersburg Unit 1 retired on May 31, 2021 consistent with the 2019 IRP Short Term Action Plan
- → Petersburg Unit 2 scheduled to retire on May 31, 2023 is consistent with the 2019 IRP Short Term Action Plan

aes Indiana

Existing Gas Resources

Gas Units	Reference Name	Technology	ICAP (MW)	UCAP (MW)	In-Service Year	Estimated Last Year In-Service
Eagle Valley						
EV CCGT	Eagle Valley	CCGT	671	601	2018	2055
Harding Street						
HS 5G	Harding Street 5	Gas ST	100	93	1958	2030
HS 6G	Harding Street 6	Gas ST	99	94	1961	2030
HS 7G	Harding Street 7	Gas ST	415	399	1973	2033
HS GT4	Harding Street GT4	Gas CT	74	67	1994	2044
HS GT5	Harding Street GT5	Gas CT	74	69	1995	2045
HS GT6	Harding Street GT6	Gas CT	154	140	2002	2052
HS GT1 & GT2	Harding Street GT1 & 2	Oil	38	36	1973	2023/2024
Georgetown						
GTOWN GT1	Georgetown 1	Gas CT	79	72	2000	2050
GTOWN GT4	Georgetown 4	Gas CT	79	75	2001	2052
		Total Gas:	1,745	1,610		
		Total Oil:	38	36		

	ICAP (MW)	UCAP (MW)
CCGT	**671**	**601**
CT	**460**	**423**
ST	**614**	**586**

aes Indiana

Existing Renewable Resources

Renewables	Technology	ICAP (MW)	UCAP (MW)	In-Service Year/ PPA Start	Estimated Last Year In-Service/PPA End
Hardy Hills					
Hardy Hills	Solar Only	195	98	2023	TBD
Petersburg Energy Center					
PEC Solar	Solar + BESS	250	125	2024	TBD
PEC BESS	Solar + BESS	180 MWh	45 MW, 4-hour	2024	TBD
PPAs					
Hoosier Wind Park (IN)	PPA	100	7	2009	2029
Lakefield Wind (MN)	PPA	200	0	2011	2031
Solar (Rate REP)	PPA	96	54	varies	varies
	Total Renewable:	841	328		

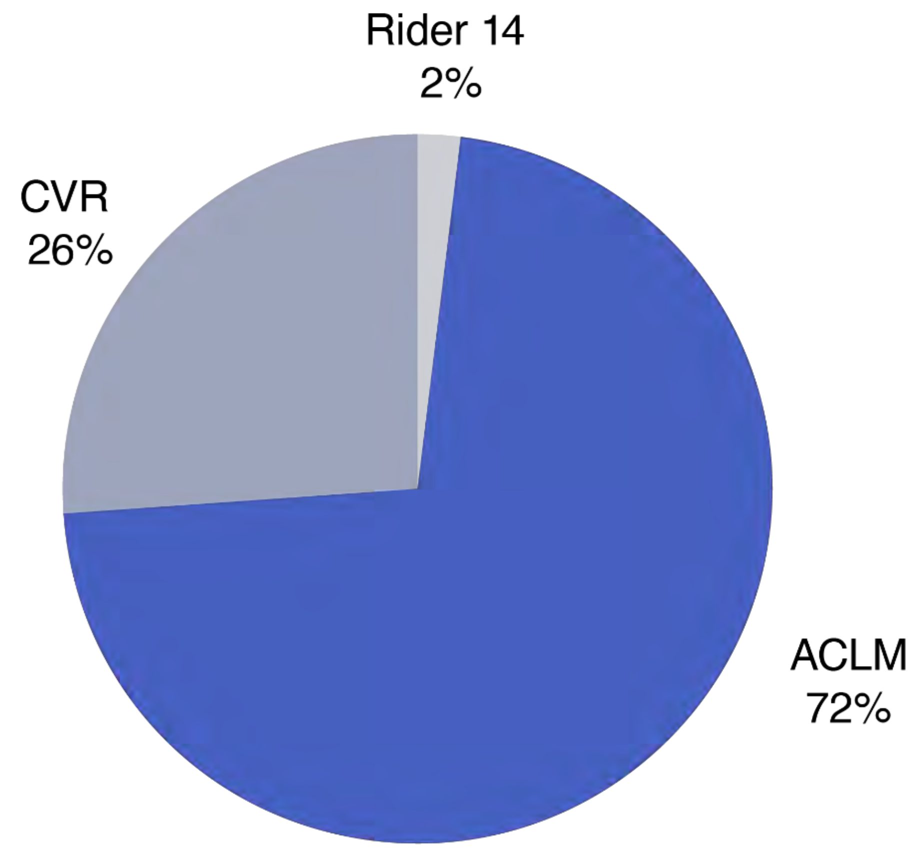
- → Lakefield Wind has no firm transmission and therefore receives no capacity credit from MISO to AES
- → Rate REP solar receives no capacity credit from MISO; rather it serves as a reduction to load in the PRA
- → UCAP values are based on current MISO capacity credit levels for renewable resources. These values will likely fall over time as renewable penetration increases within MISO.

	ICAP (MW)	UCAP (MW)
Solar	**541**	**277**
Wind	**300**	**7**
Storage	**45**	**43**

Existing DSM Resources

DEMAND RESPONSE

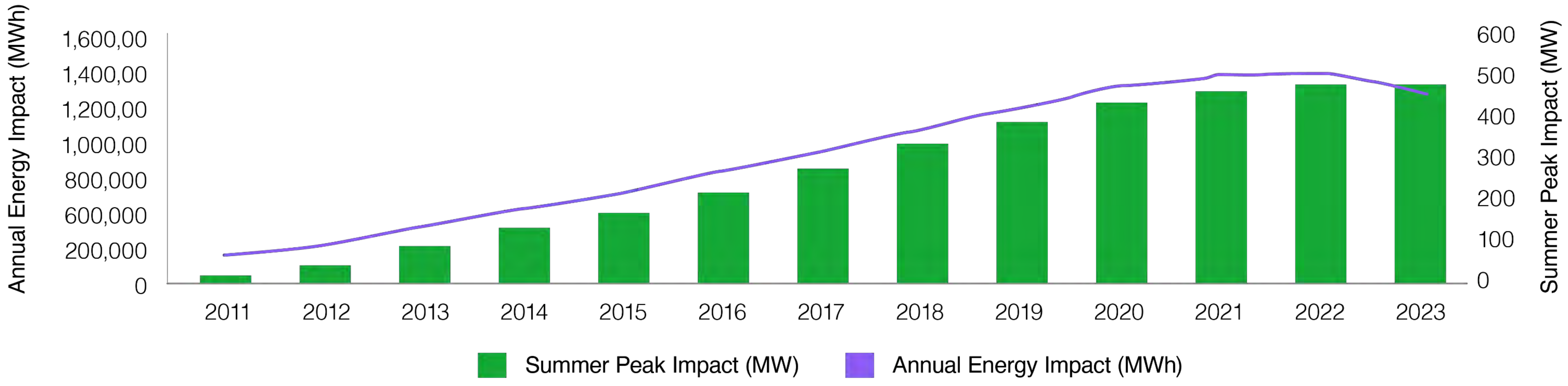
Load Modifying Resources	Summer Capacity Value (MW)
Air Conditioner Load Management	46.3
Conservation Voltage Reduction	16.8
Rider 14	1.1



ENERGY EFFICIENCY

→ Avg annual incremental program savings of 1% per year of 2021 sales

→ Savings of approximately 10% of 2021 sales from measures installed to date



aes Indiana

Replacement Resource Options

Erik Miller, Manager, Resource Planning, AES Indiana

Commercially Available Replacement Resources

DSM/EE

→ EE & DR Measures bundled into traunches for planning model selection

Wind

→ Land-Based Wind

Solar

→ Utility-Scale
→ C&I
→ Residential

Storage

→ Standalone Front-of-meter
→ Solar + Storage
→ Wind + Storage

Natural Gas

→ CCGT
→ CT
→ Reciprocating Engine/ICE

Optionality for Emerging Technologies

The energy sector is transforming, and many new generation technologies are under development that can be utilized to support AES Indiana's commitment to achieve our customers' goals of reliability, affordability and sustainability.

These technologies include but may not be limited to:

- →Green Hydrogen
- →Small Modular Reactors (SMRs)
- →Gravity Energy Storage
- →Pumped-hydro Storage
- →Carbon Capture and Sequestration (CCS)

As a company, we see these technologies as providing optionality in a path towards reducing carbon and we plan to consider them in future IRPs as they become commercially available.

AES Indiana welcomes stakeholder input regarding new & emerging technologies.

2022 Integrated Resource Plan (IRP)

Baseline Energy & Load Forecast

Presented by Itron

Itron

aes Indiana

Introduction to the Itron Team

- Itron has over 30 years of experience developing forecast models for customers worldwide. Itron's energy forecasting group is nationally recognized for its expertise in short-term forecasting (hour-ahead and day-ahead), financial forecasting (1-3 years-ahead), and long-term forecasting (10-20 years-ahead).
  We are a leading provider of forecasting solutions to independent system operators (ISO), regional transmission organizations, energy retailers, public utilities, municipalities, and cooperatives.
- Itron specializes in long-term load modeling, regulatory support, statistical analysis, and forecasting system implementation. The forecasting staff includes economists, statisticians, programmers, and consultants that have extensive experience in these areas, as well as database design and software development.

Eric Fox

Director, Forecasting Solutions

Michael Russo

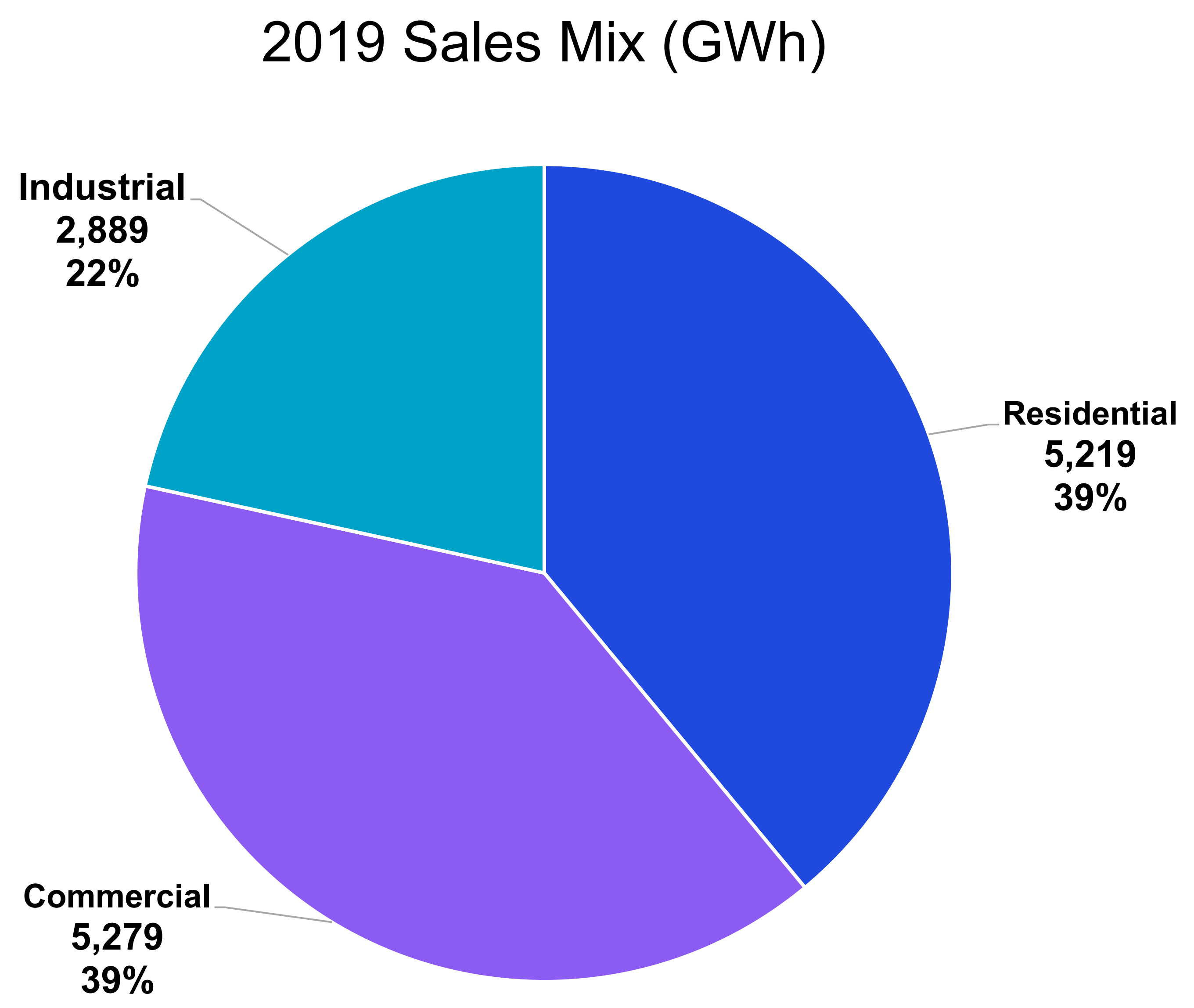
Forecast Consultant

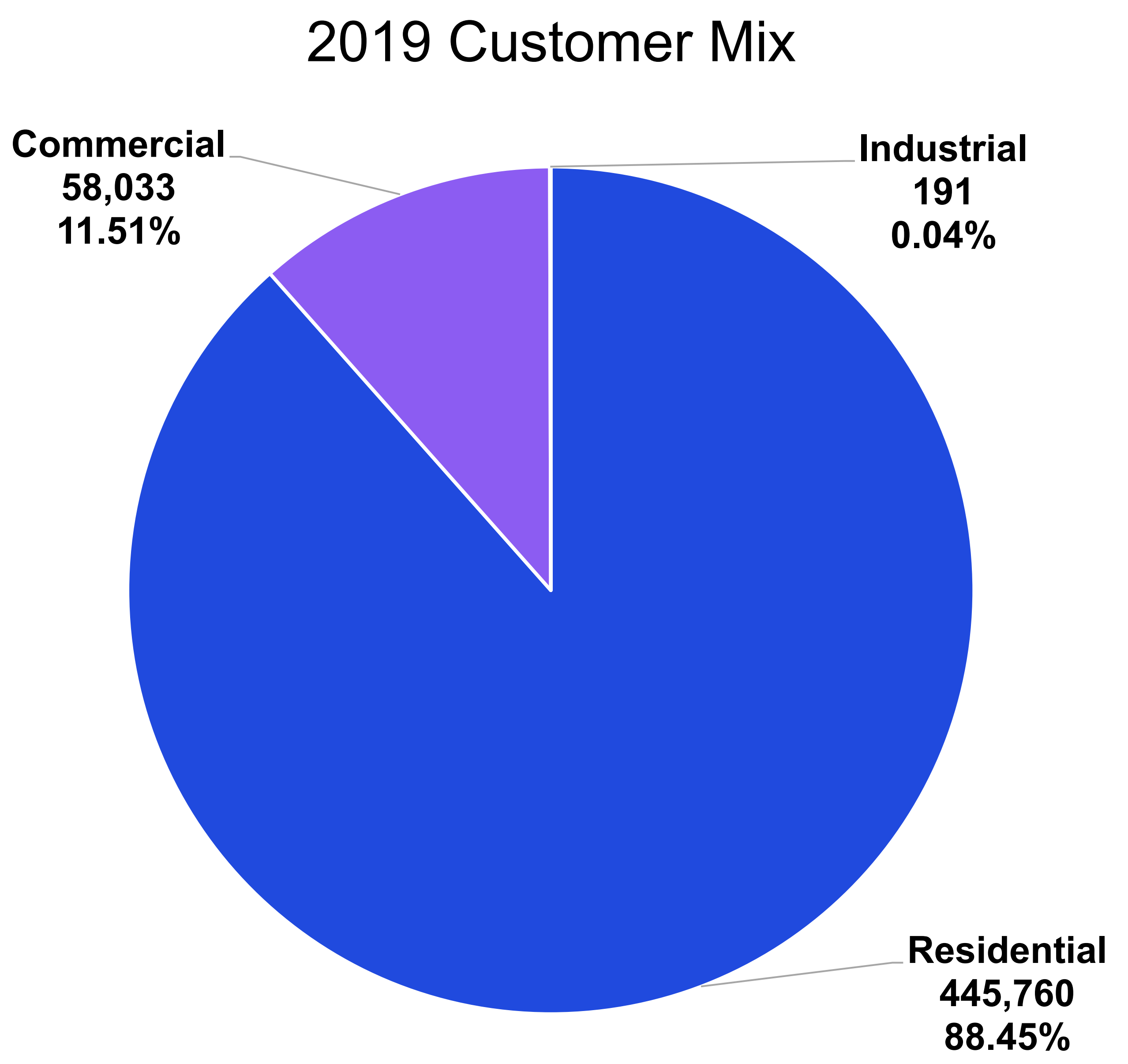
Agenda

- → Sales, Energy, and Demand Trends
- → Modeling Approach
- → Baseline Forecast

Sales, Energy and Demand Trends

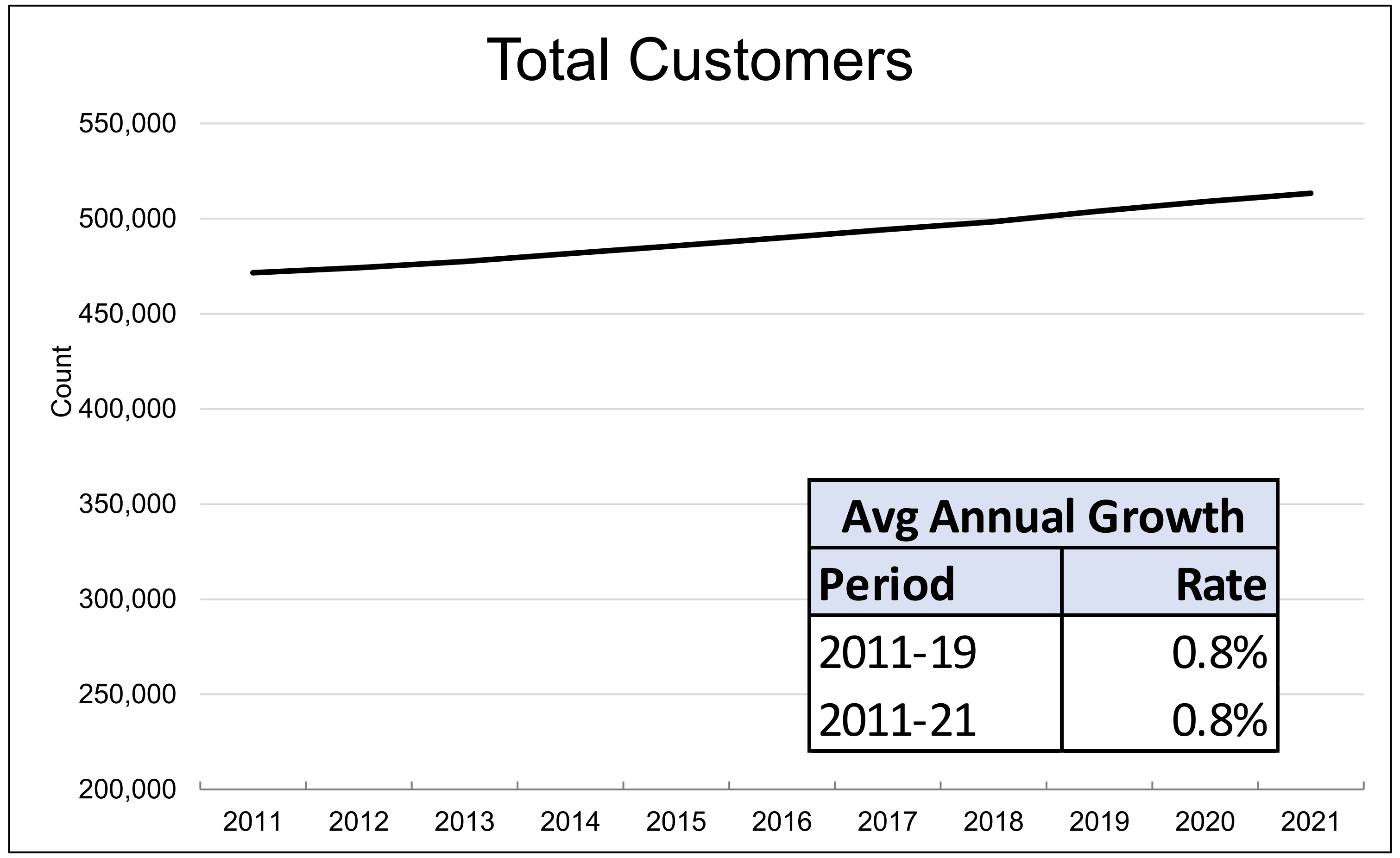
AES Indiana Customer Class Mix

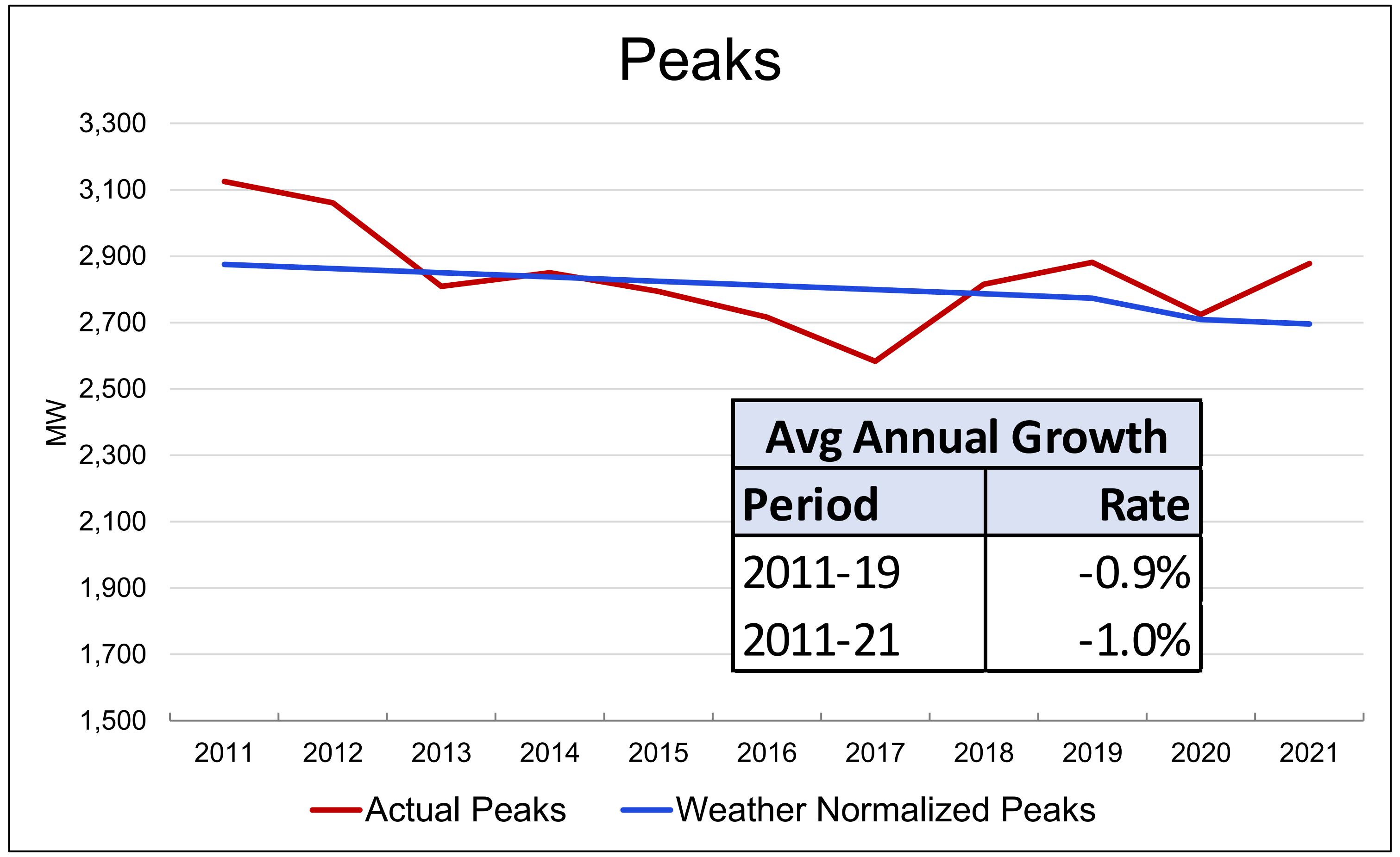


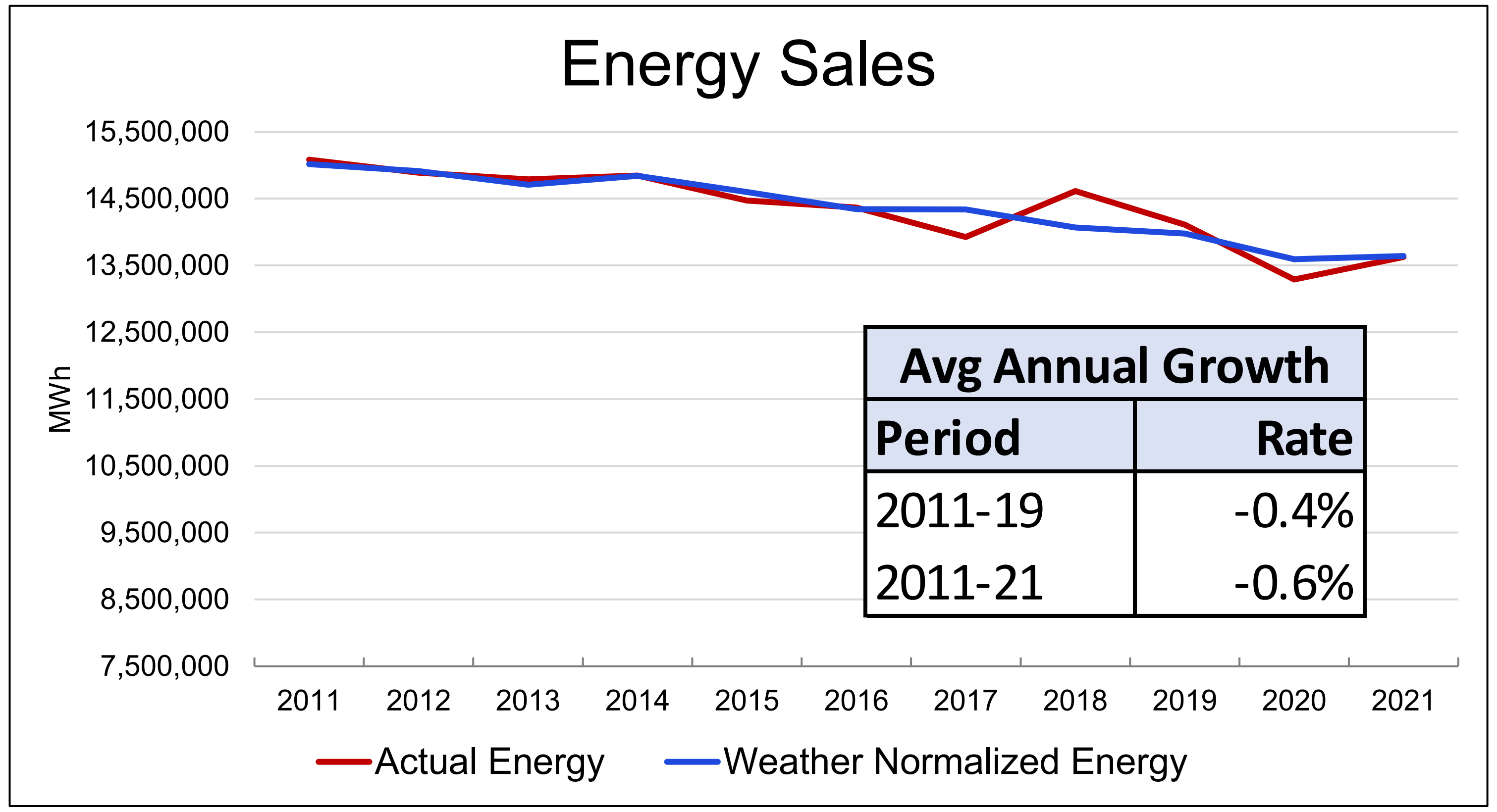


AES Indiana serves over 500,000 customers across residential, commercial, and industrial customer class. The residential class accounts for nearly 90% of the customers and 40% of system sales. Commercial sales 40%. Industrial sales 20%.

Historical Energy, Peak, and Customer Trends

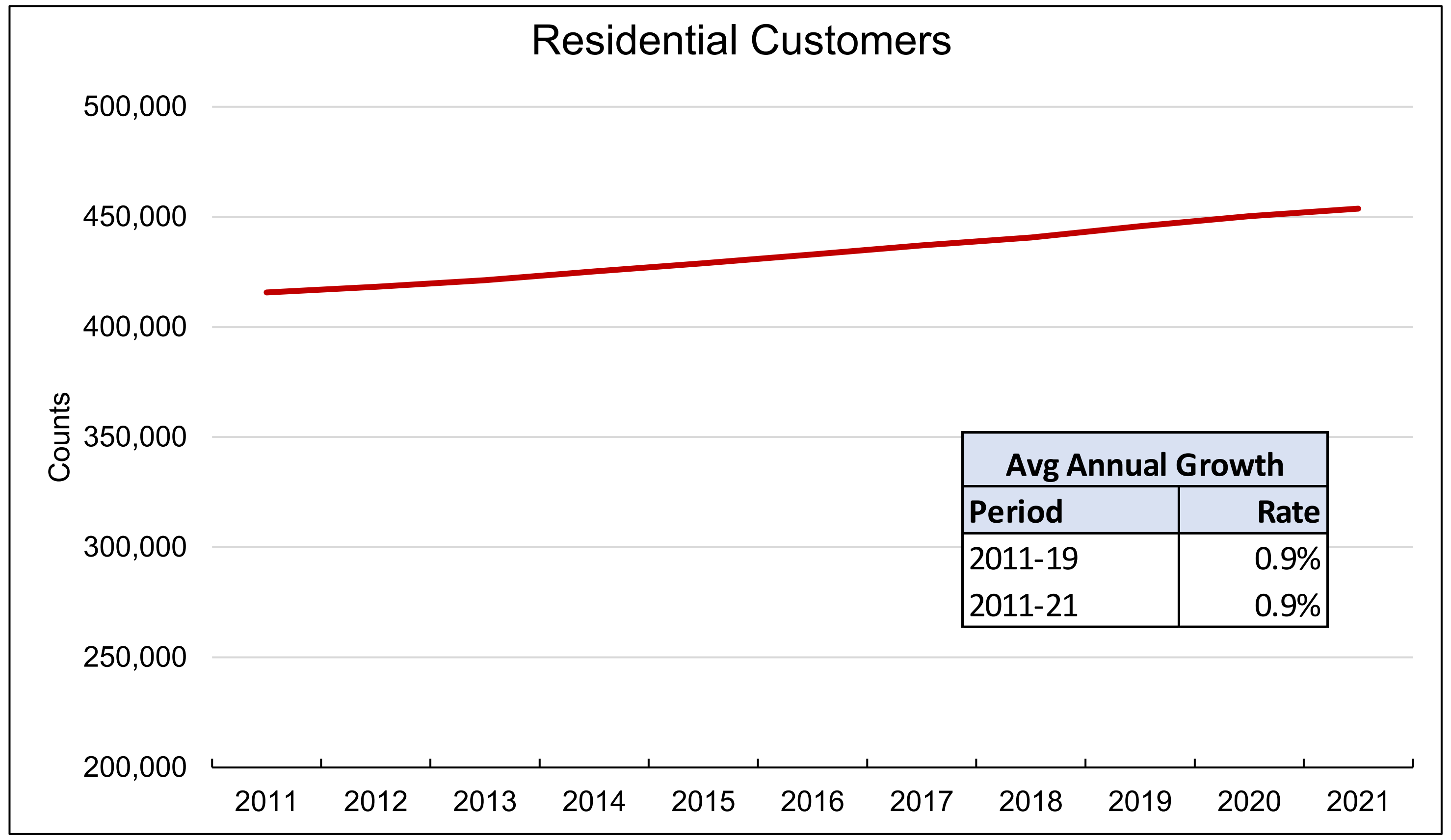


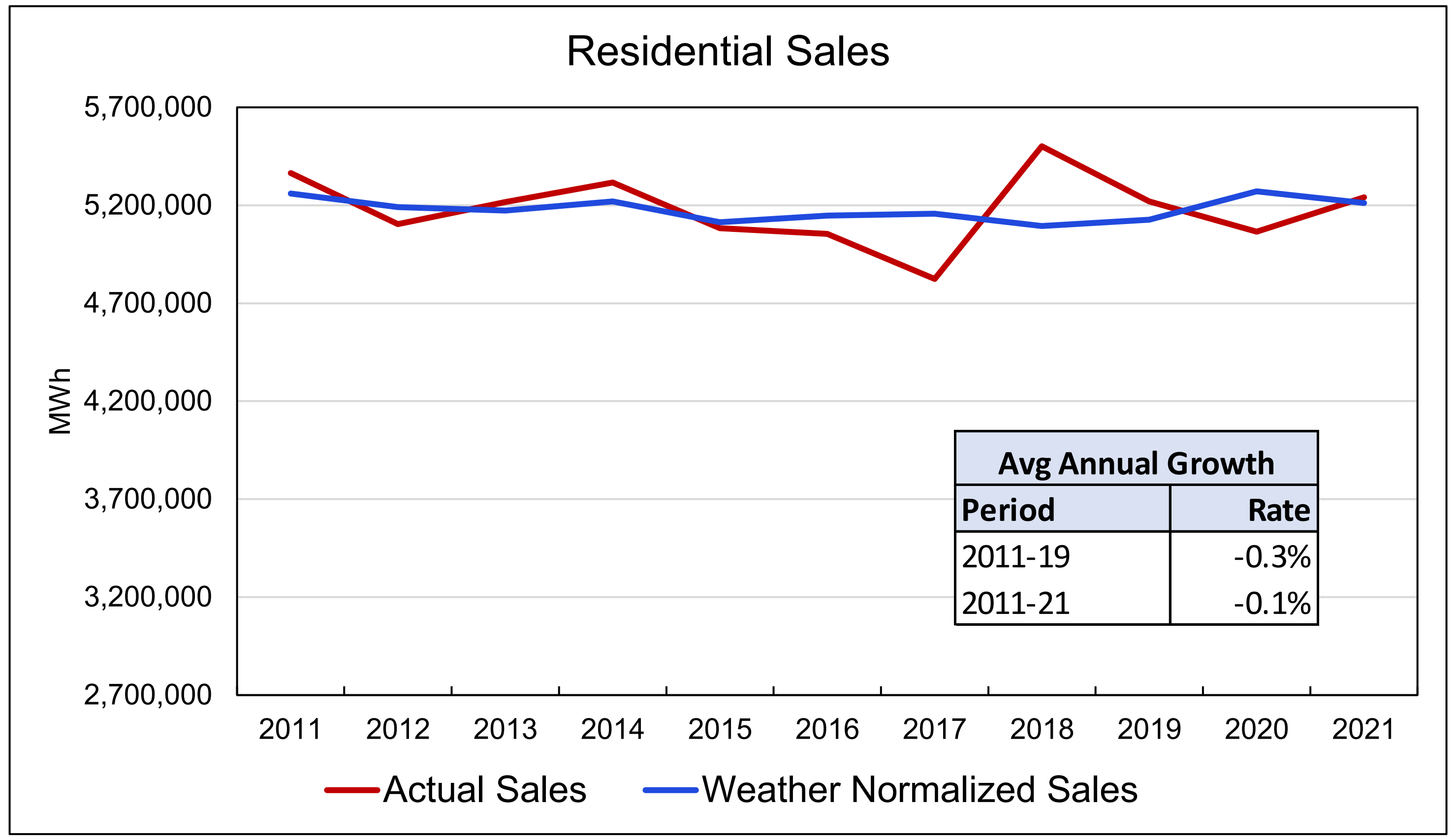




Despite relatively strong customer growth, system energy and peak demand has been declining as efficiency gains have outweighed customer growth

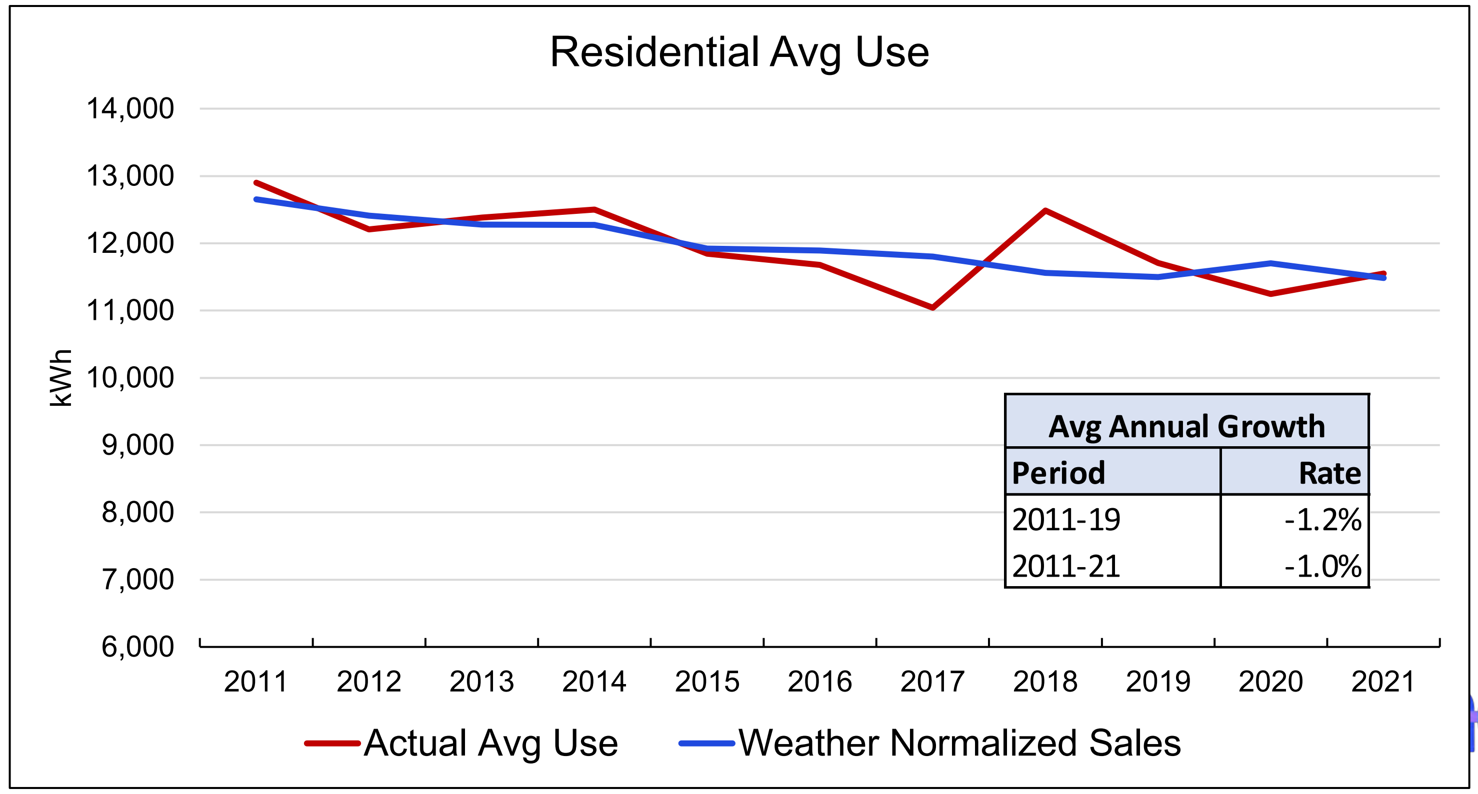
Residential Customer and Sales Trends





The number of customers has increased from 417,000 in 2010 to 455,500 by year-end 2021. Adding approximately 3,500 new customers per year.

But despite strong customer growth, sales have been flat with average use declining at roughly the same rate as customer growth.



aes Indiana

What's Driving Customer Growth

Strong population and household growth

→ Home to over 876,000 people and more than 2 million residents in the metropolitan area. Third most populous city in the Midwest behind Chicago and Columbus. Population projected to grow 26% over the next 30 years

Strong regional economy

→ Regional GDP over $126 billion (Fed Reserve Bank of St. Louis)

→ Employment growth 1.7% year over year, over 1 million employed in the metro area

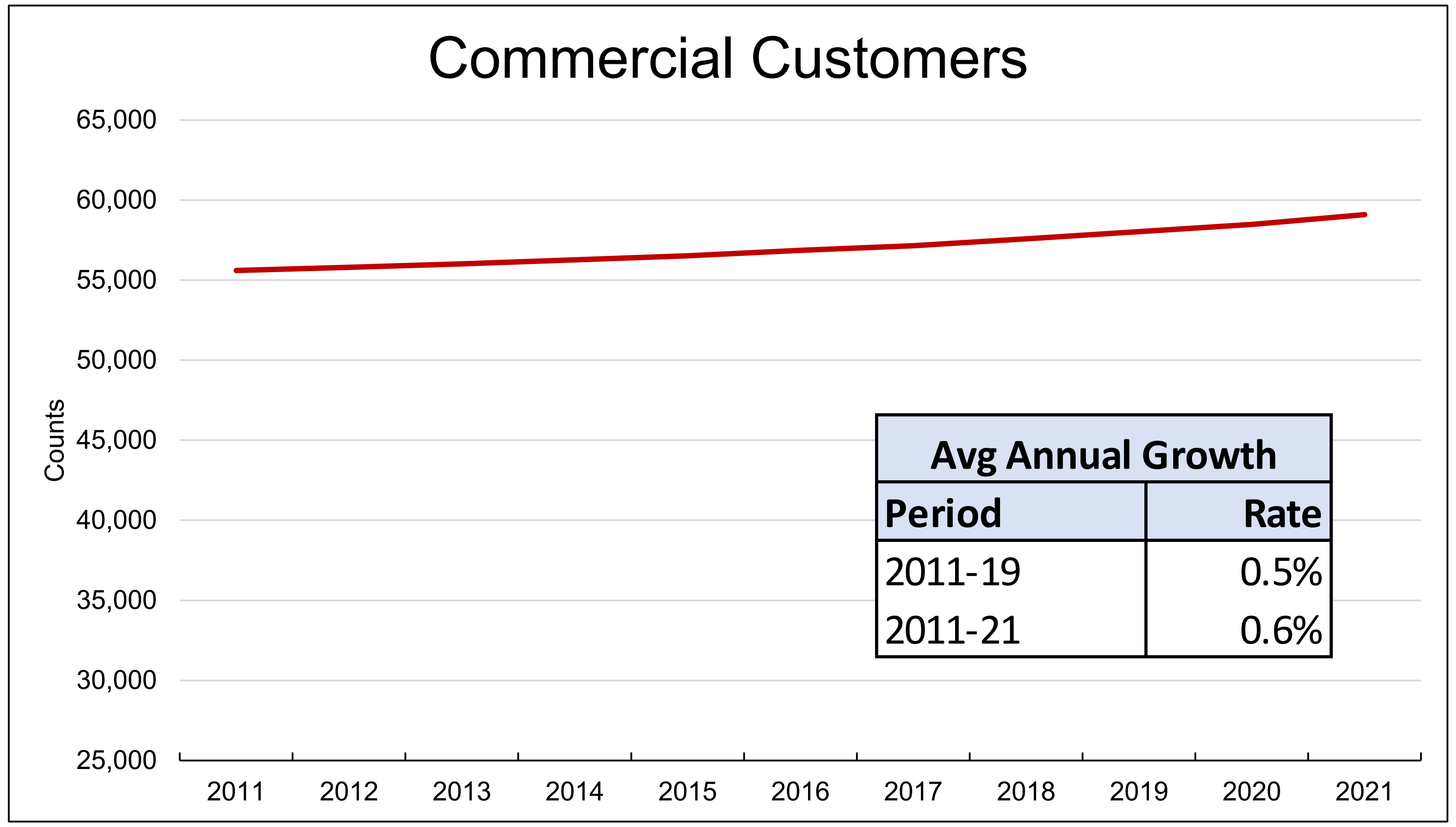
Affordable Housing

→ According to Kiplinger's, Indianapolis has an affordability index of 1 out of 10, (based on percent of income needed to buy a median price home, $185,000)

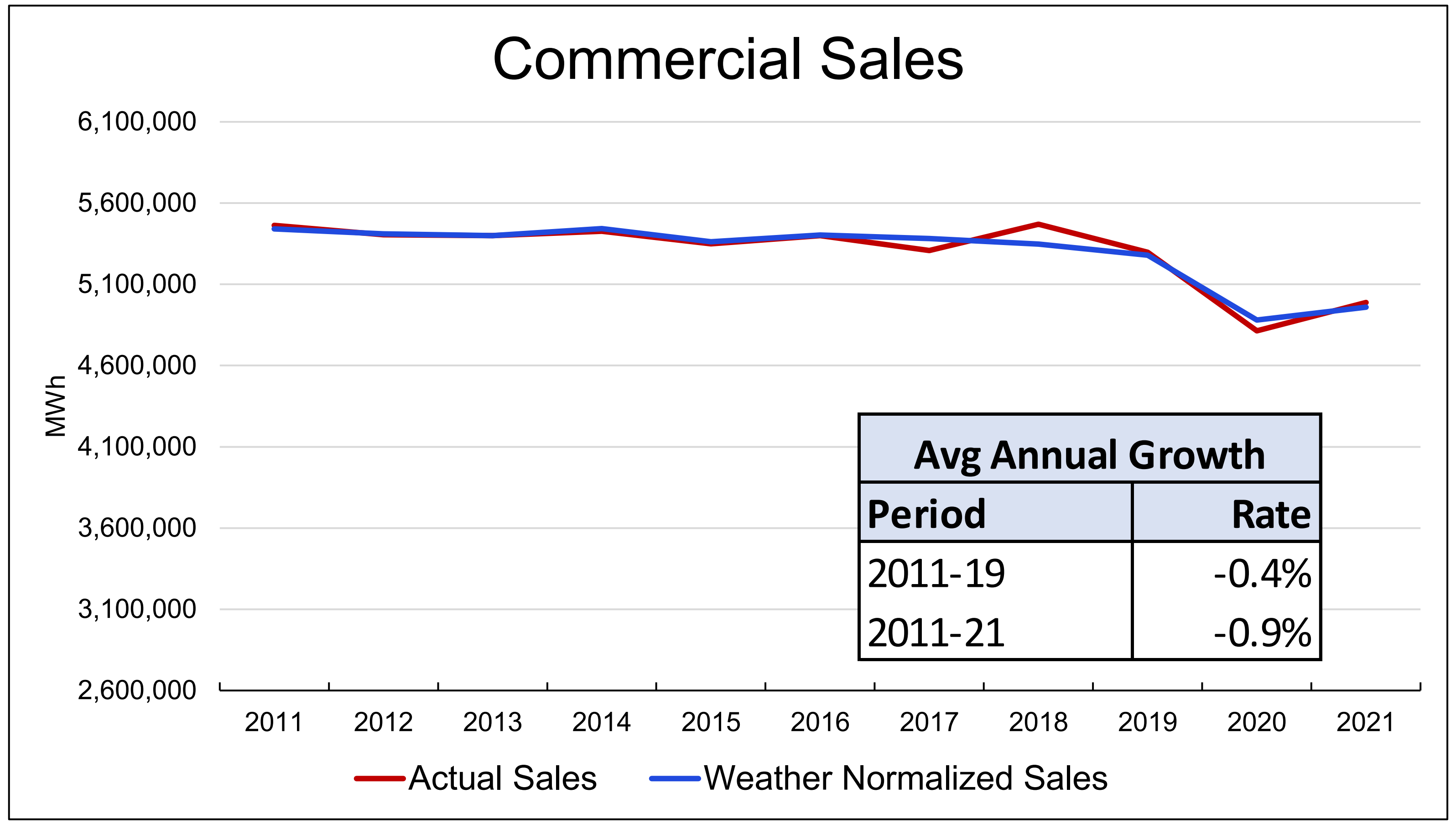
The Indianapolis real estate market: stats & trends for 2021 (roofstock.com)

https://www.kiplinger.com/article/real-estate/t010-c000-s002-home-price-changes-in-the-100-largest-metro-areas.html

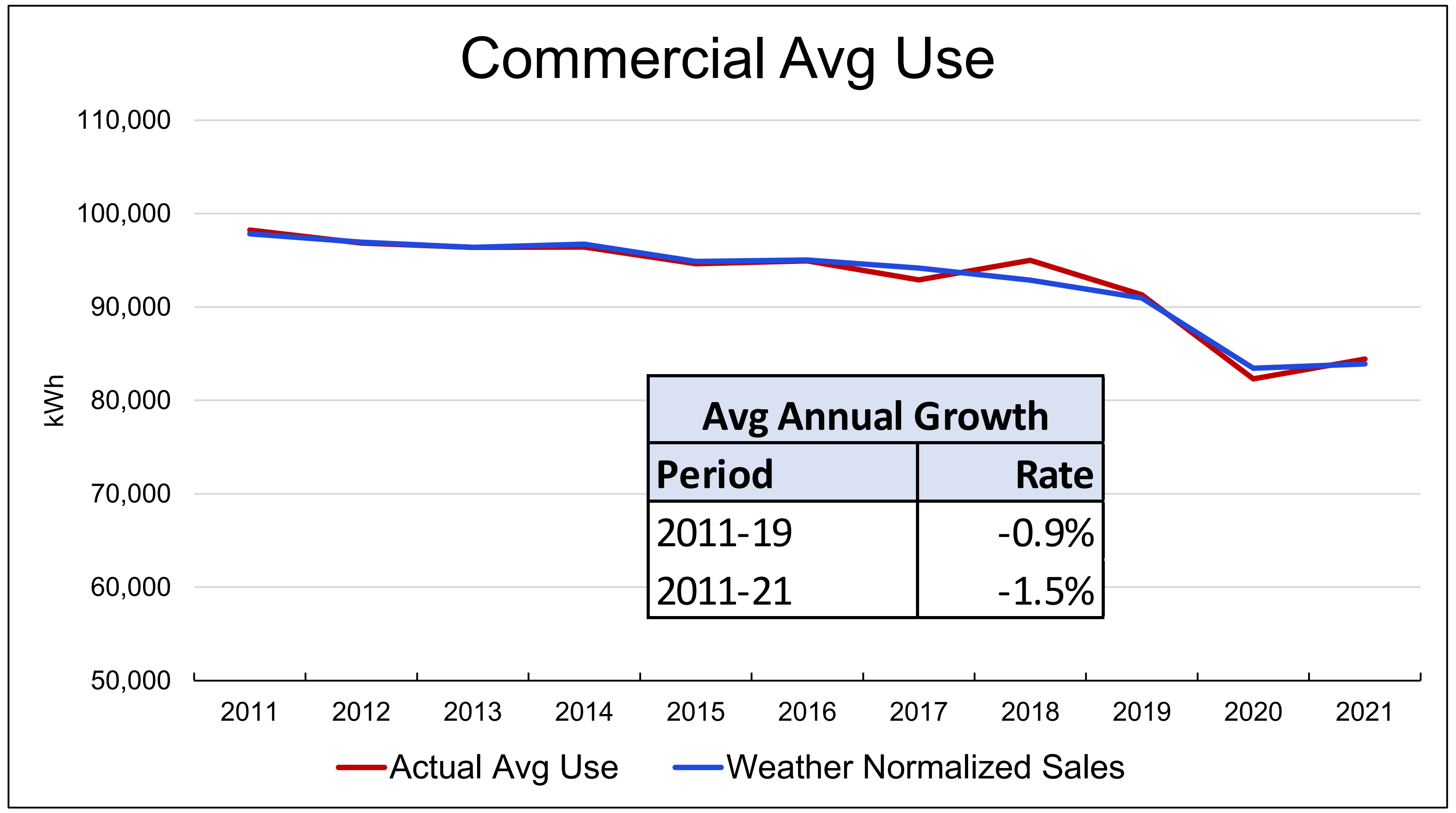
Commercial Sales and Customer Trends



Avg Annual Growth	
Period	Rate
2011-19	0.5%
2011-21	0.6%



Avg Annual Growth	
Period	Rate
2011-19	-0.4%
2011-21	-0.9%



Avg Annual Growth	
Period	Rate
2011-19	-0.9%
2011-21	-1.5%

→ Strong efficiency improvements in the commercial sector

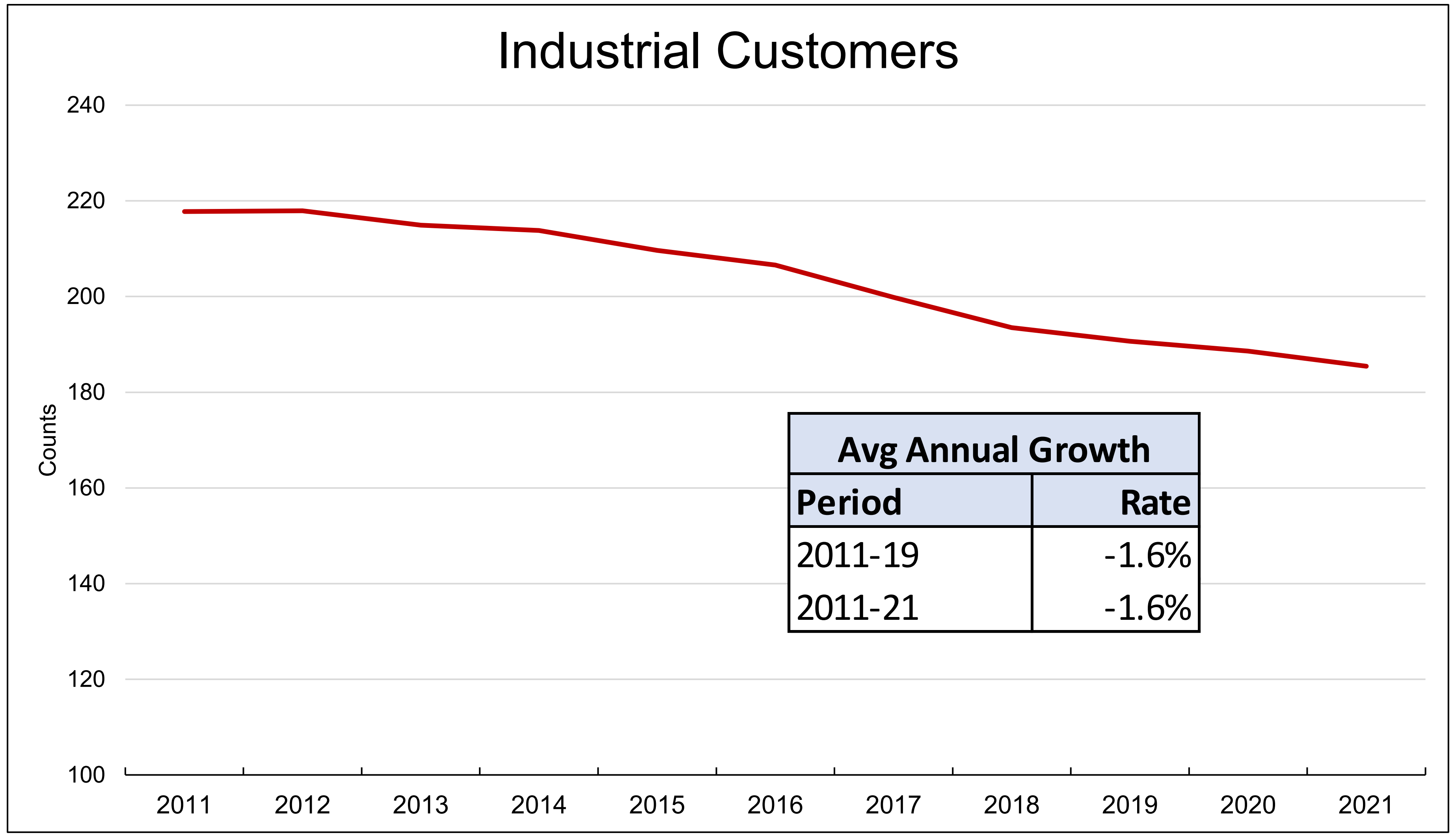
→ AES Energy Efficiency Program Activity

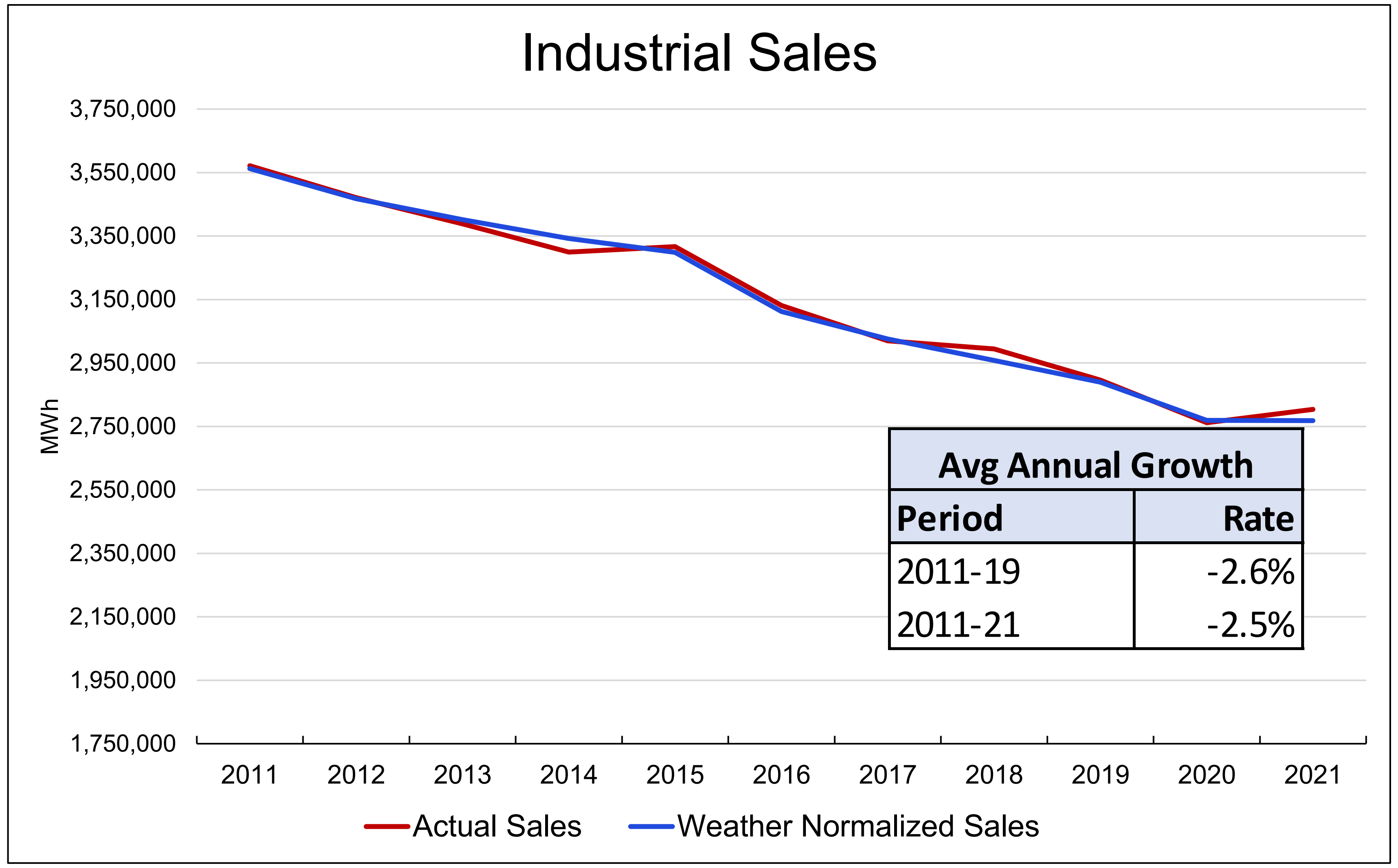
→ LED Adoption

→ Sharp drop in 2020 sales due to COVID-19

Itron aes Indiana

Industrial Trends – AES's Largest Customers





→Industrial customers and sales have been trending down since 2010, but appears to be leveling off

→Manufacturing transitioning to less energy intensive industry mix and end-use processes, and strong efficiency gains.

Itron aes Indiana

Who are AES's largest customers

INDIANAPOLIS MSA TOP EMPLOYERS

	# EMPLOYEES
ST. VINCENT HEALTH	± 30,000
IU HEALTH	± 30,000
COMMUNITY HEALTH	± 14,000
ELI LILLY AND CO	± 10,000
KROGER	± 9,000
IUPUI	± 7,000
SIMON PROPERTY GROUP	± 5,000
ANTHEM BLUE CROSS BLUE SHIELD	± 5,000
ROCHE DIAGNOSTICS	± 4,000
FEDEX HUB	± 4,000
ROLLS ROYCE	± 4,000
ALLISON TRANSMISSION	± 3,000
ONE AMERICA	± 2,000
IU SCHOOL OF MEDICINE	± 2,000

- → What is classified as industrial, includes significant commercial activity
- → Health care
- → Education
- → Office - Management/Administrative
- → Distribution
- → The distinction between commercial and industrial activity is blurring
- → AES's 10 largest customers account for approximately 14% of sales

CBRE
indianapolis-multifamily-market-overview-2020-e.pdf (cbre.us)

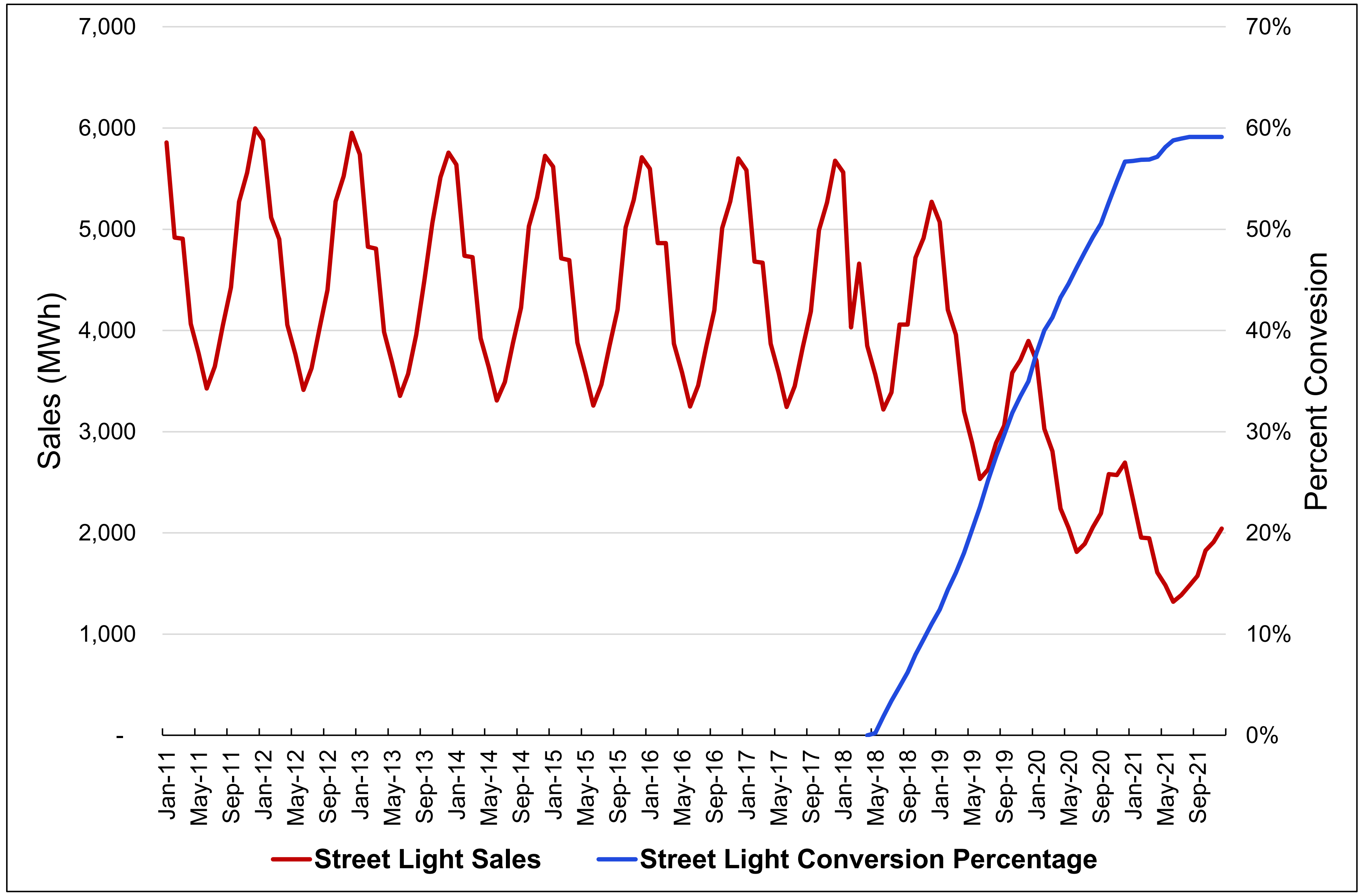
Street Lighting: LED Conversion Program

Operation Night Light is a public-private sector partnership that began in 2016 between the City of Indianapolis and AES Indiana. By converting to high-efficiency LED technology, the city would see savings generated due to lower maintenance costs and energy usage.

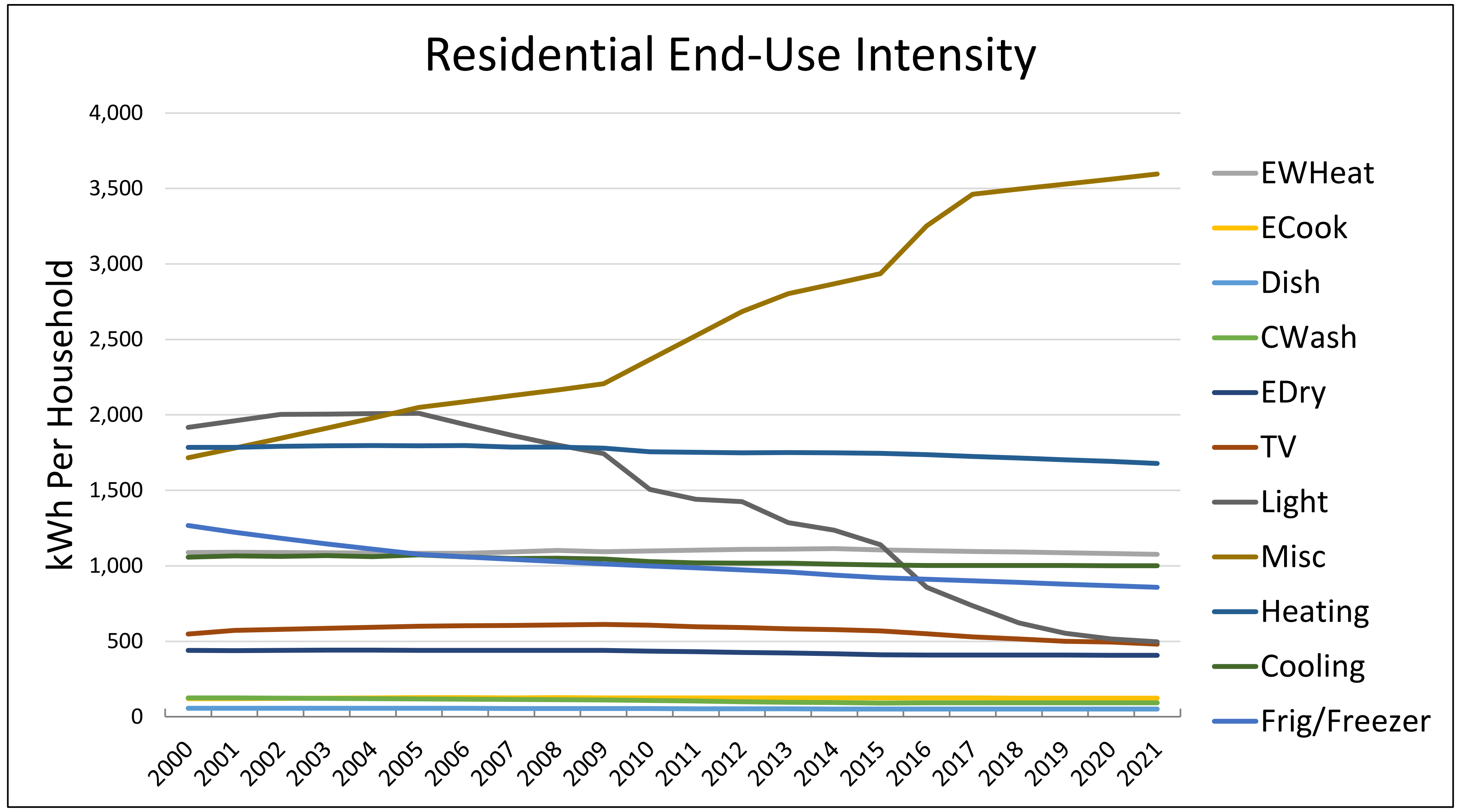
→27,000 streetlights across Marion County have been converted to high-efficiency LED fixtures

→Since the LED program began, electricity usage is down over 67%

→New lights will continue to be installed through 2025

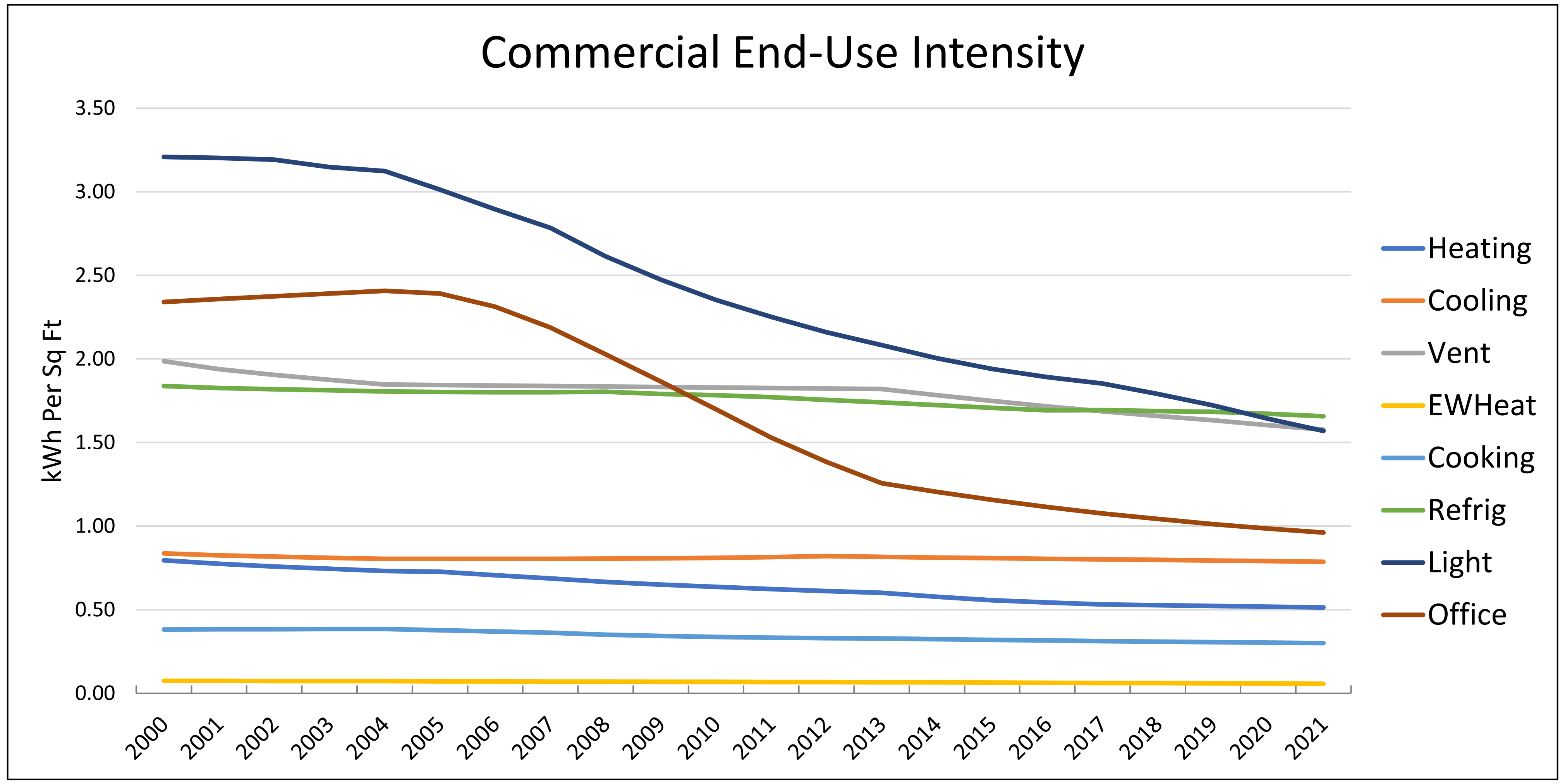


Why is Average Use Declining ?



→ Residential. End-use intensities have been declining across nearly all end-uses except miscellaneous. Over the last 10 years:

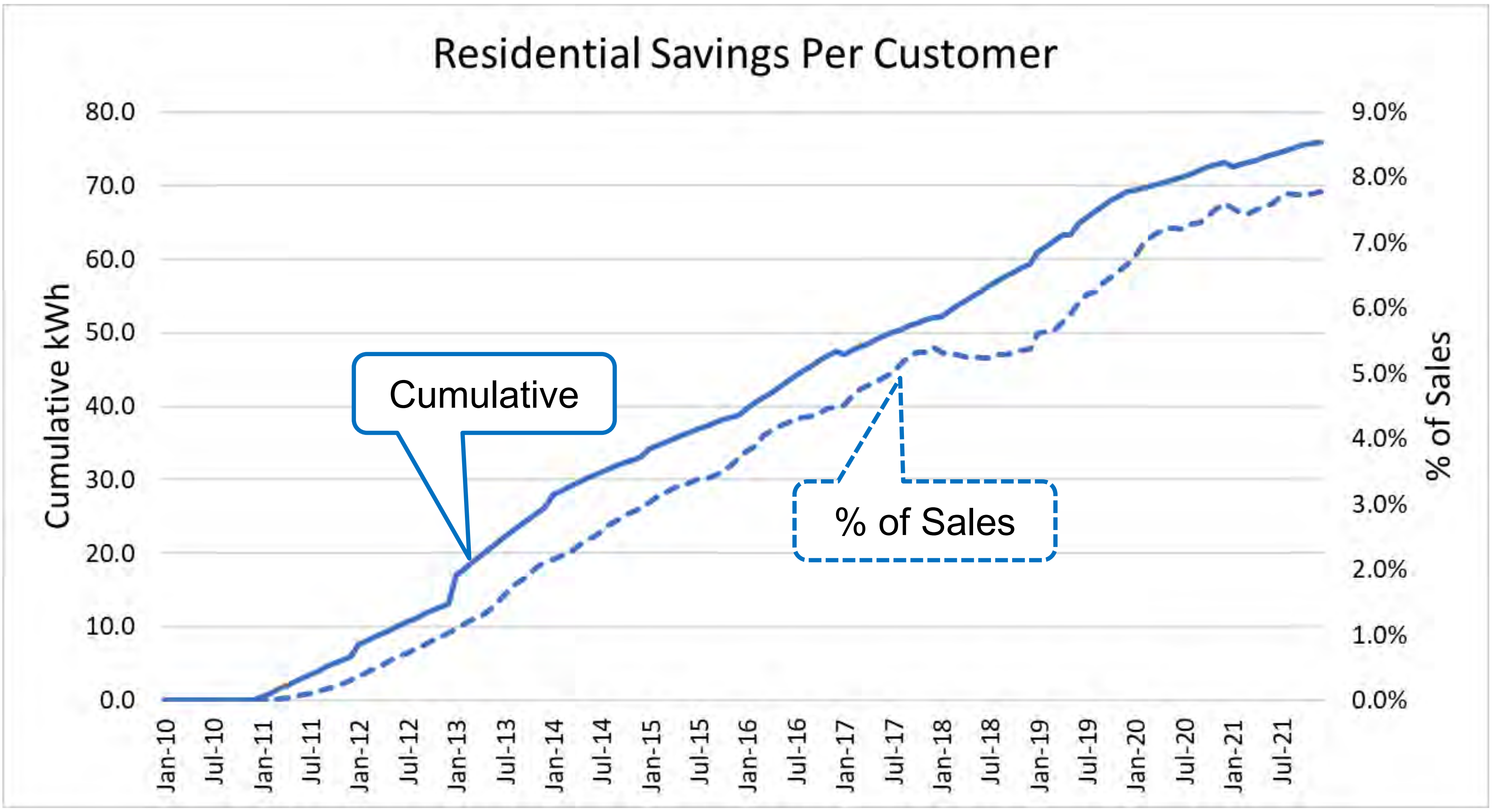
- → Heating down 0.5%
- → Cooling down 0.4%
- → Base down 0.2%

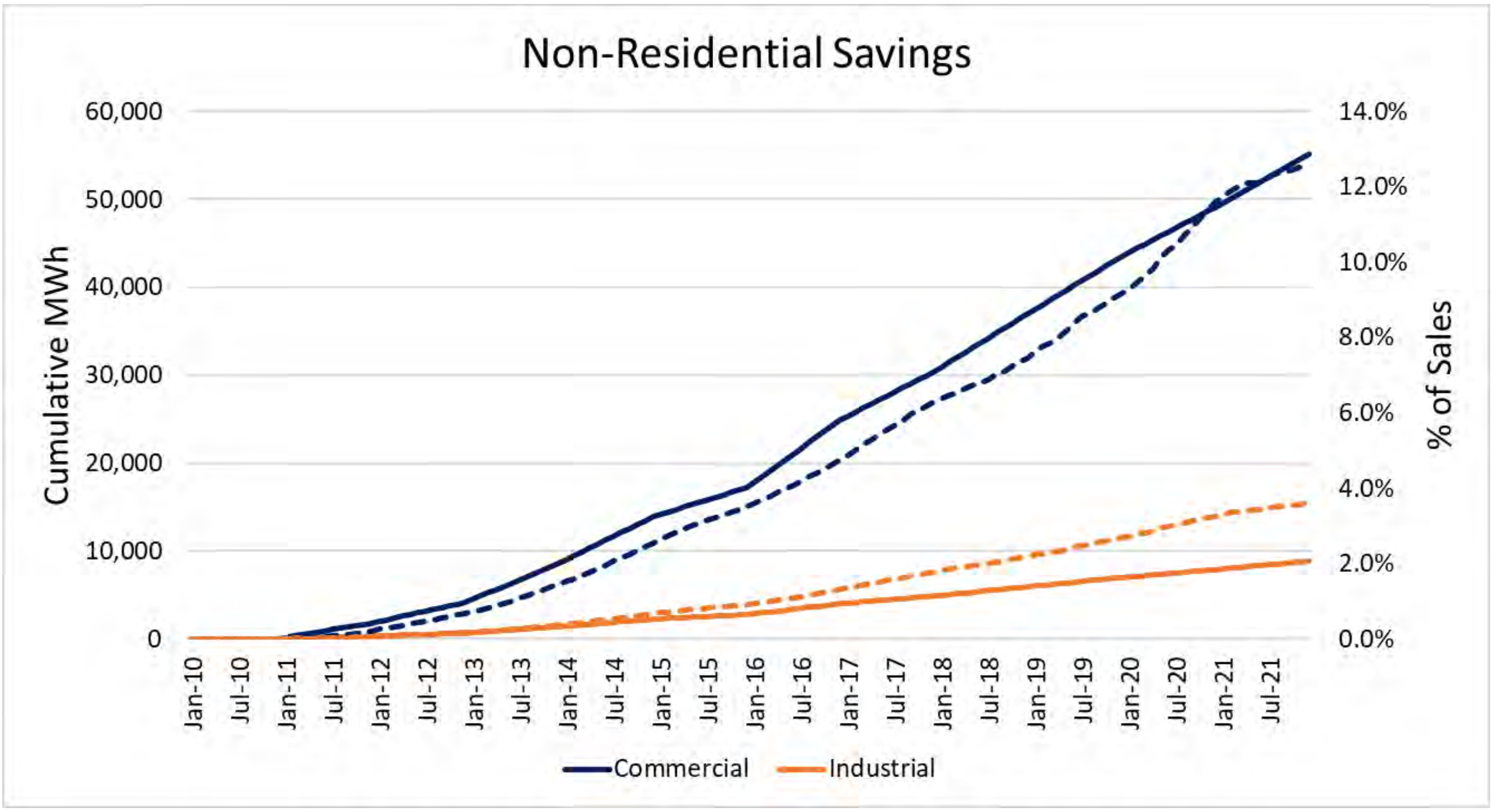


→ Similar trends in the commercial sector with the strongest decline in lighting and computer related loads. Over the last 10 years:

- → Heating down 1.9% (minimal commercial heating)
- → Cooling down 0.2%
- → Base down 1.2%

Significant Energy Efficiency Program Activity





- → Energy Efficiency Programs have had a significant impact on sales
  - → Reduce residential average use by 8% over the last ten years
  - → And reduce commercial sales by 13%

Annual Cumulative Saving (MWh)

Year	Res	Com	Ind
2011	30,123	21,547	3,456
2012	66,290	49,406	7,923
2013	133,328	103,074	16,530
2014	170,356	166,836	26,756
2015	201,208	206,761	33,158
2016	247,829	299,311	48,001
2017	274,827	365,279	58,580
2018	315,502	444,192	71,235
2019	372,124	522,340	83,768
2020	396,524	589,484	94,536

Modeling Approach

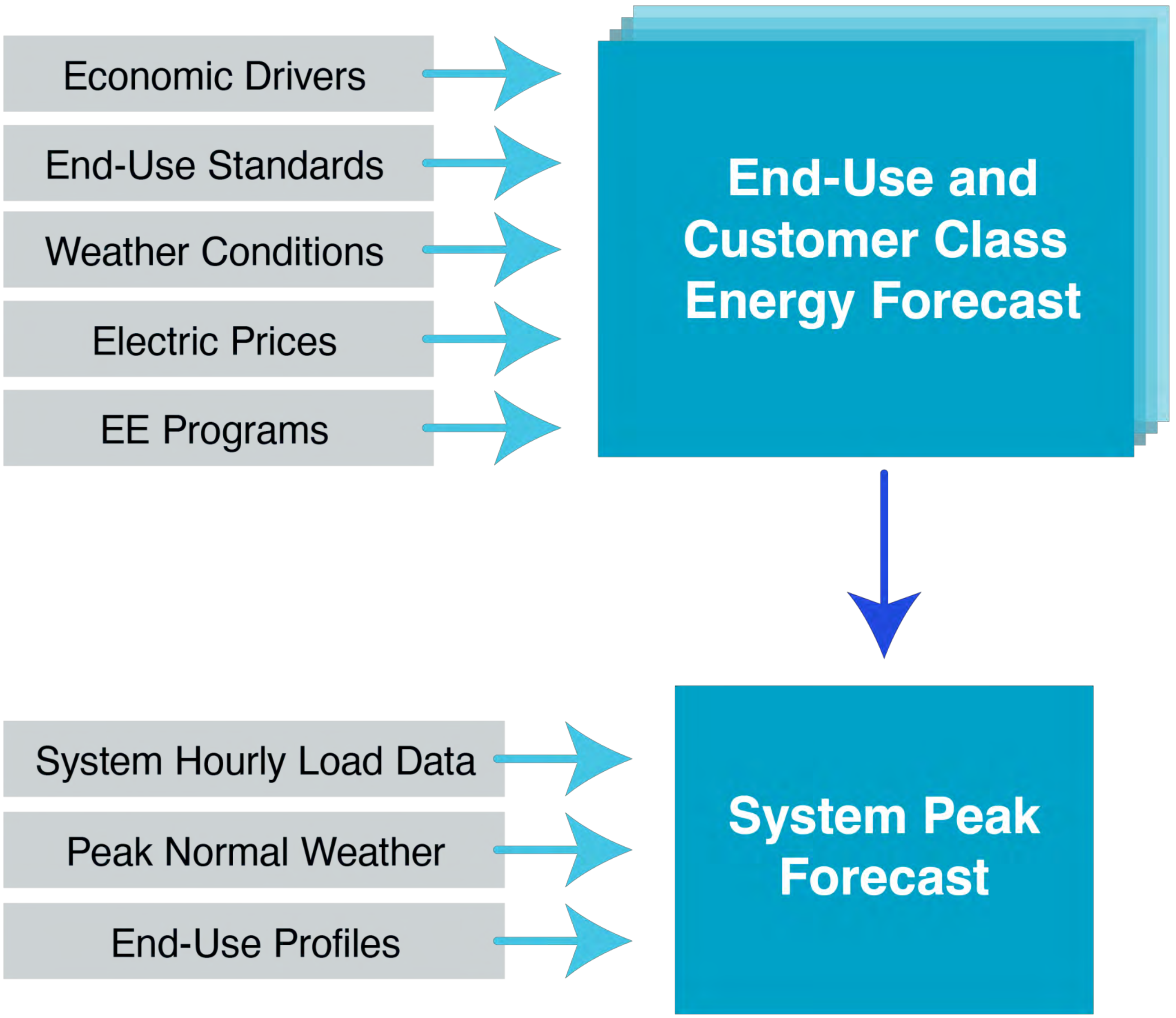
Baseline Modeling Approach

- → Bottom-up Modeling Approach
- → Estimate rate-class level sales and customer models from historical billed sales data
- → Sales/energy driven by households, economic forecasts, expected weather conditions, price, and end-use efficiency improvements. End-use demand drives system peak demand

Monthly sales and customer models are estimated for:

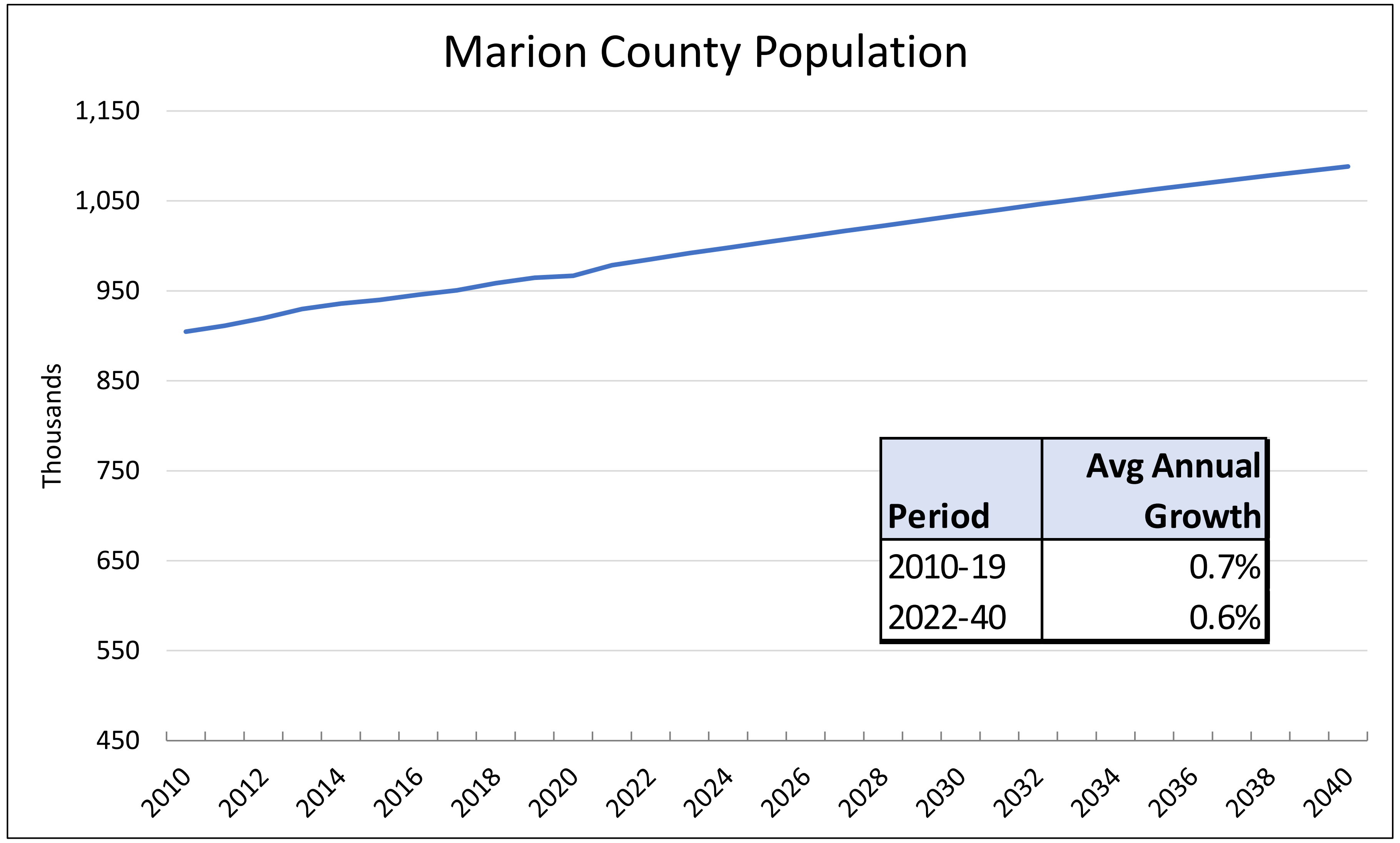
- → Residential
- → Commercial
- → Industrial
- → Other (Lighting)

Monthly peak model driven by end-use energy forecasts



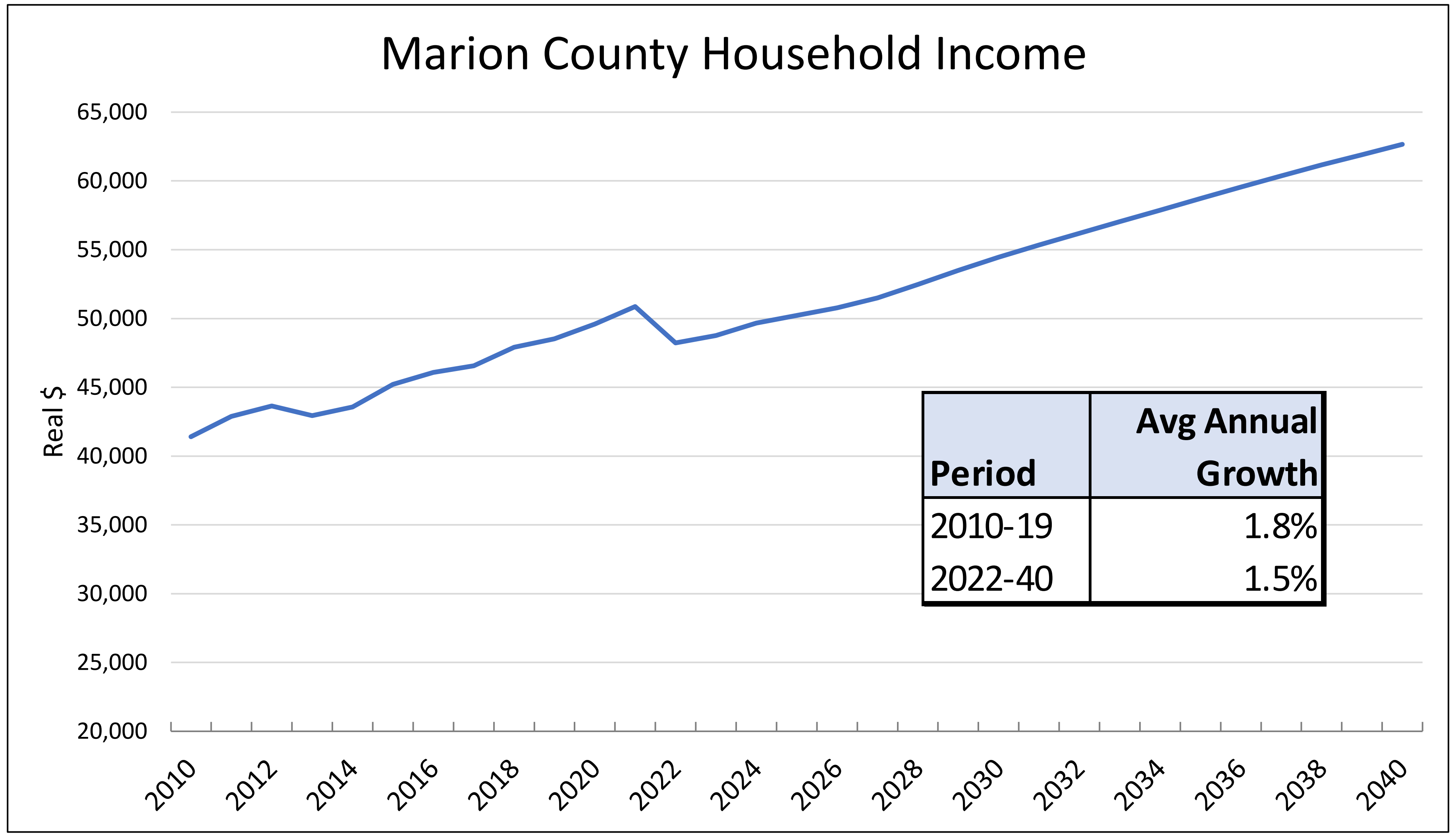
THE BASELINE FORECAST EXCLUDES BEHIND THE METER SOLAR, ELECTRIC VEHICLE LOADS, AND FUTURE EE PROGRAM SAVINGS

Residential Economic Drivers



Period	Avg Annual Growth
2010-19	0.7%
2022-40	0.6%

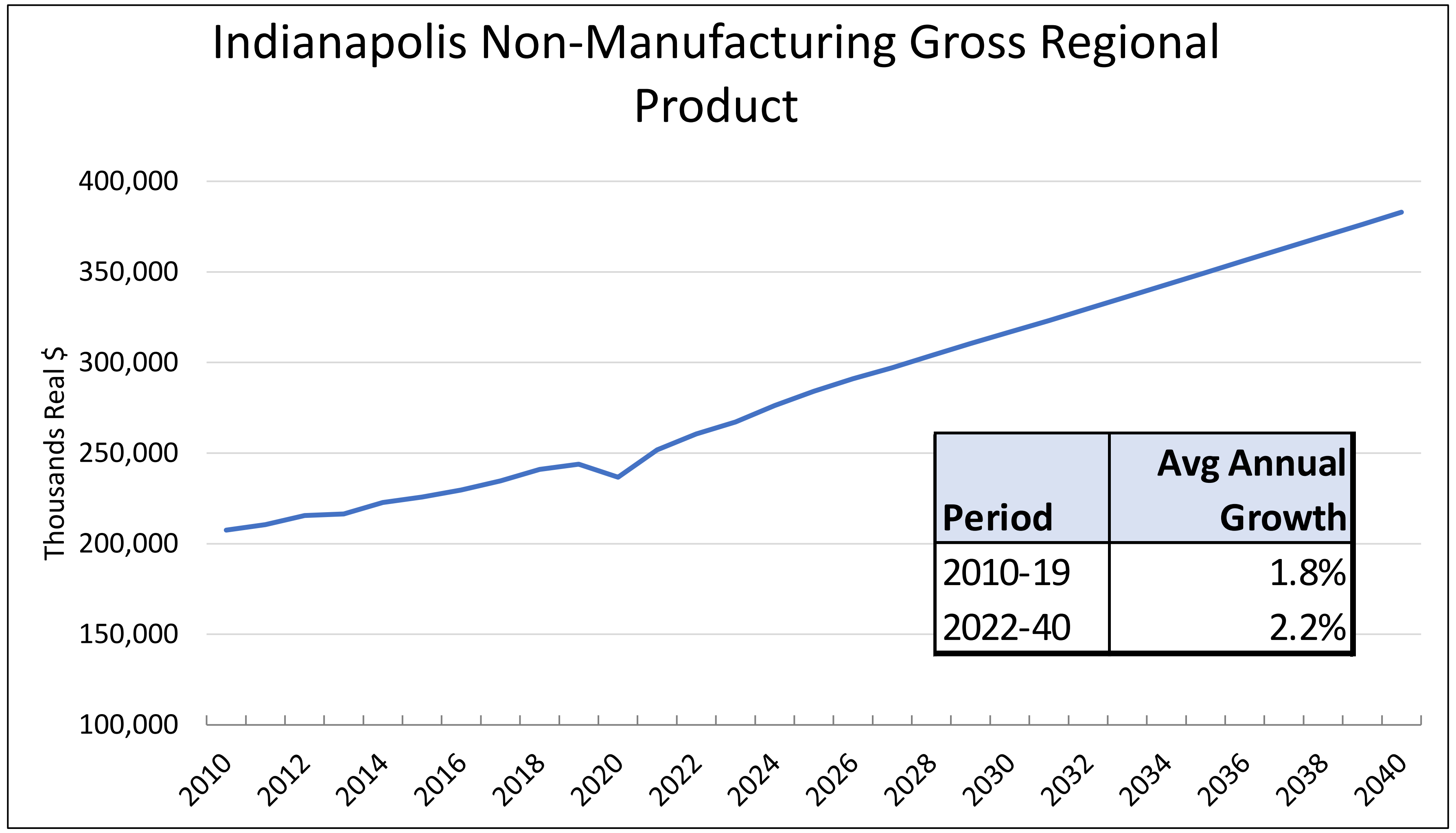
- → Moody Analytics (August 2021), economic forecast for Marion County.
- → Population projections drive the residential customer forecast. Expected population growth slightly slower than the last ten years.



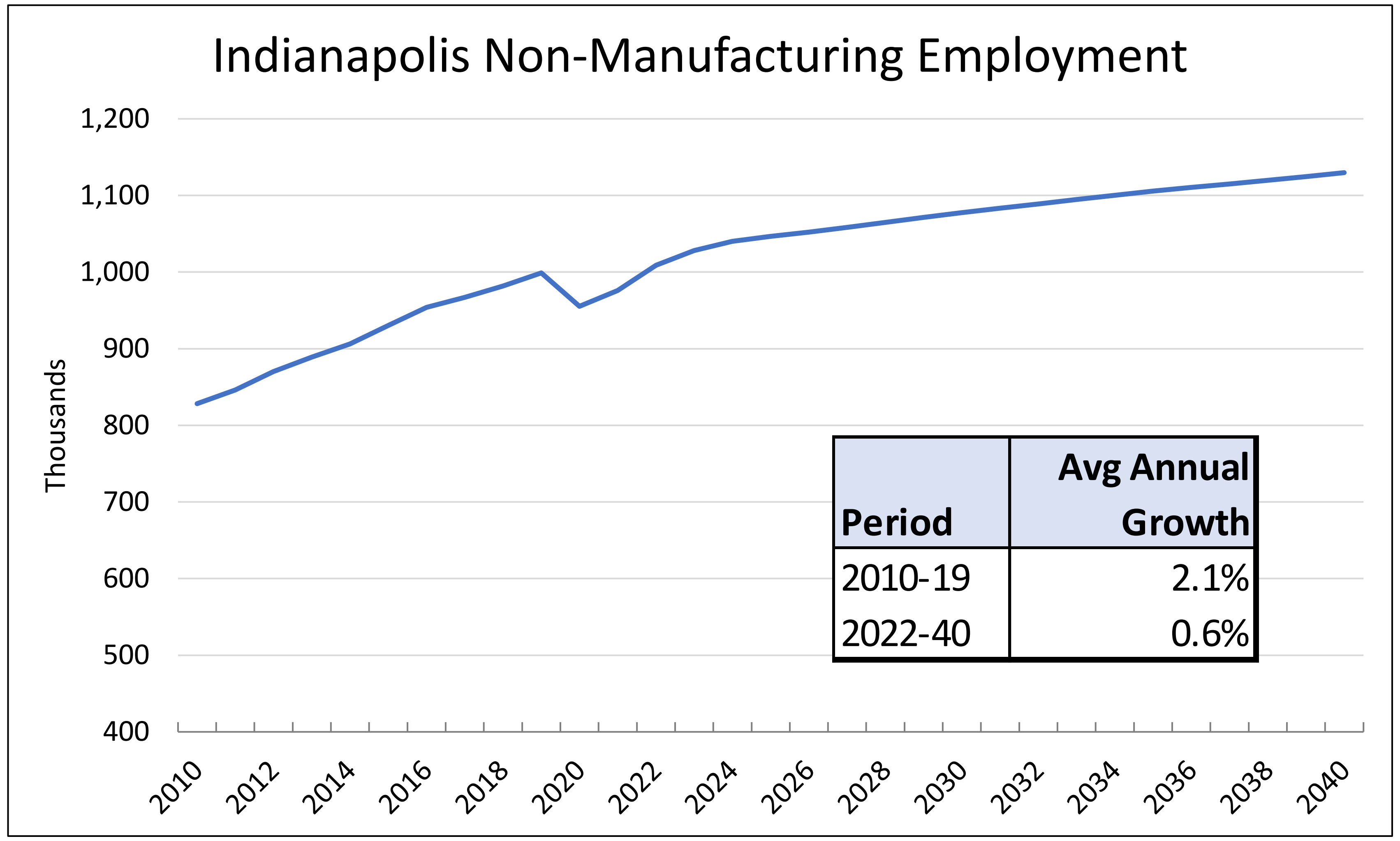
Period	Avg Annual Growth
2010-19	1.8%
2022-40	1.5%

- → Household income influences customer use.
- → Real income growth slightly lower than prior ten-years.

C&I Economic Drivers



Period	Avg Annual Growth
2010-19	1.8%
2022-40	2.2%



Period	Avg Annual Growth
2010-19	2.1%
2022-40	0.6%

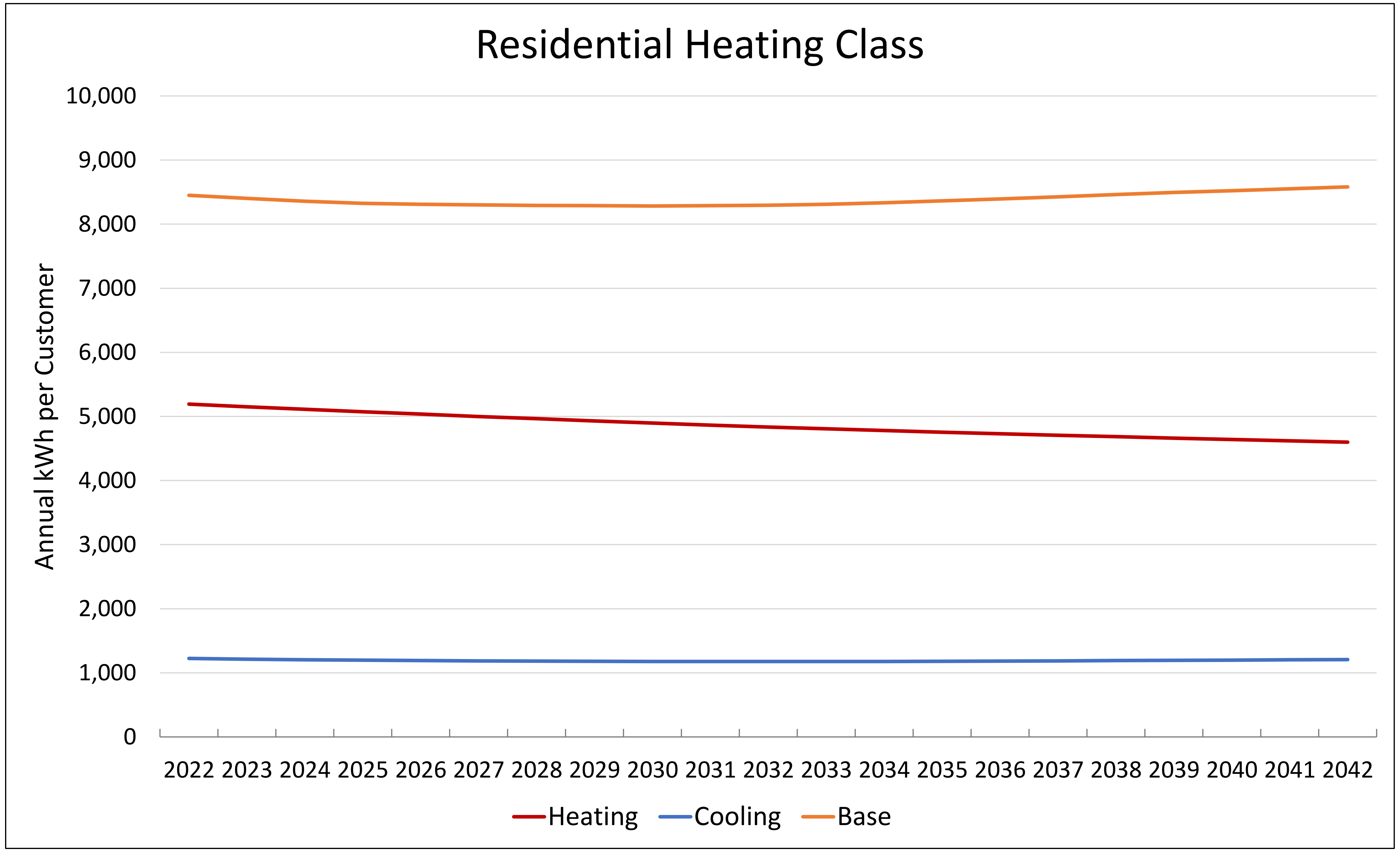
→Non-manufacturing output tracks U.S. growth

→Slower employment growth in the out years. Implies higher long-term productivity.

Residential End-Use Intensity Projections

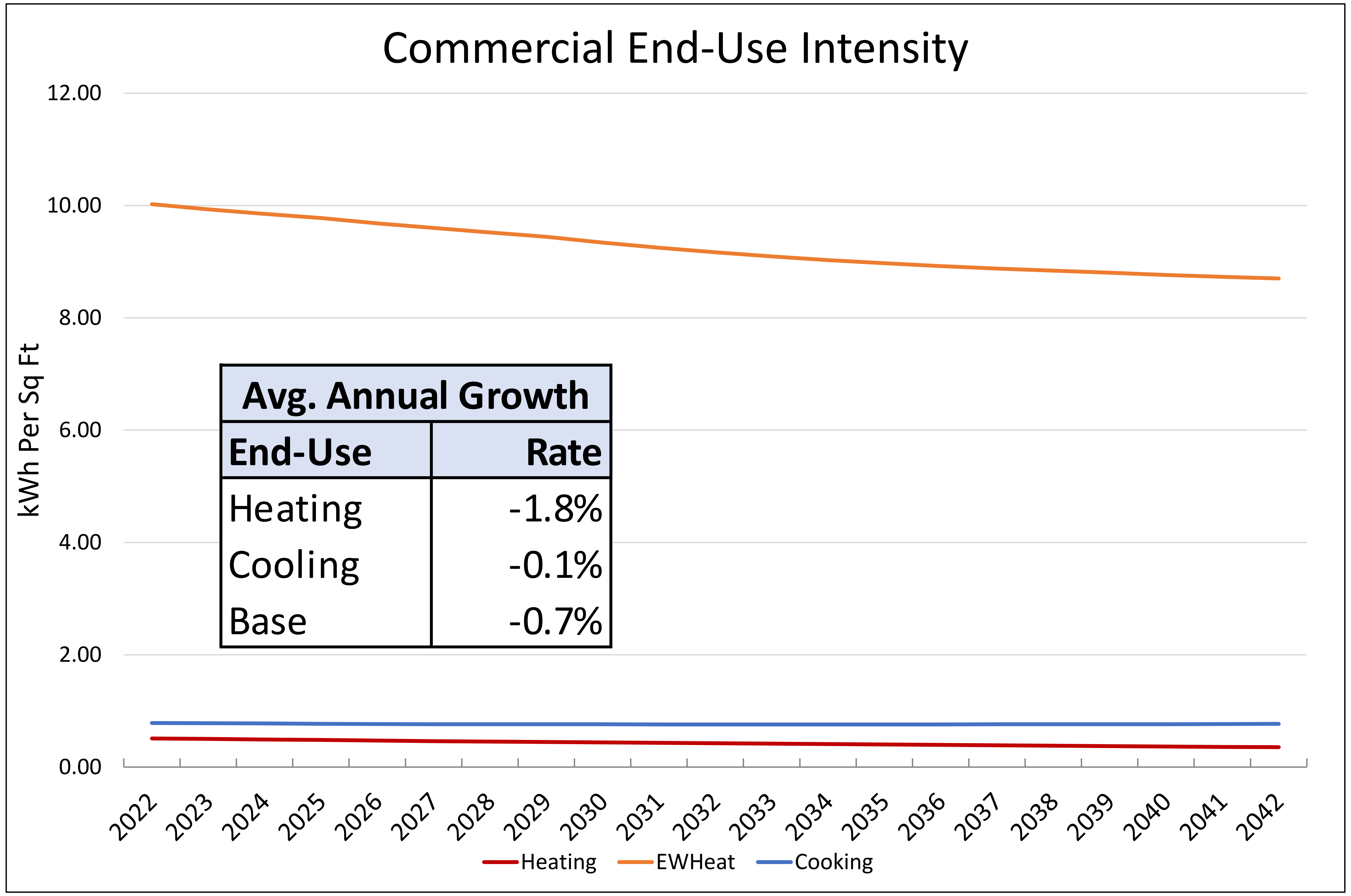
- End-Use intensities based on end-use saturation and average stock efficiency derived from EIA' Annual Energy Outlook (AEO) for East North Central Census Division.
- Residential calibrated to AES service area based on historical appliance saturation surveys and DSM potential study.

Avg. Annual Growth	
End-Use	**Rate**
Heating	-0.6%
Cooling	-0.1%
Base	0.1%



Commercial End-Use Intensity Projections

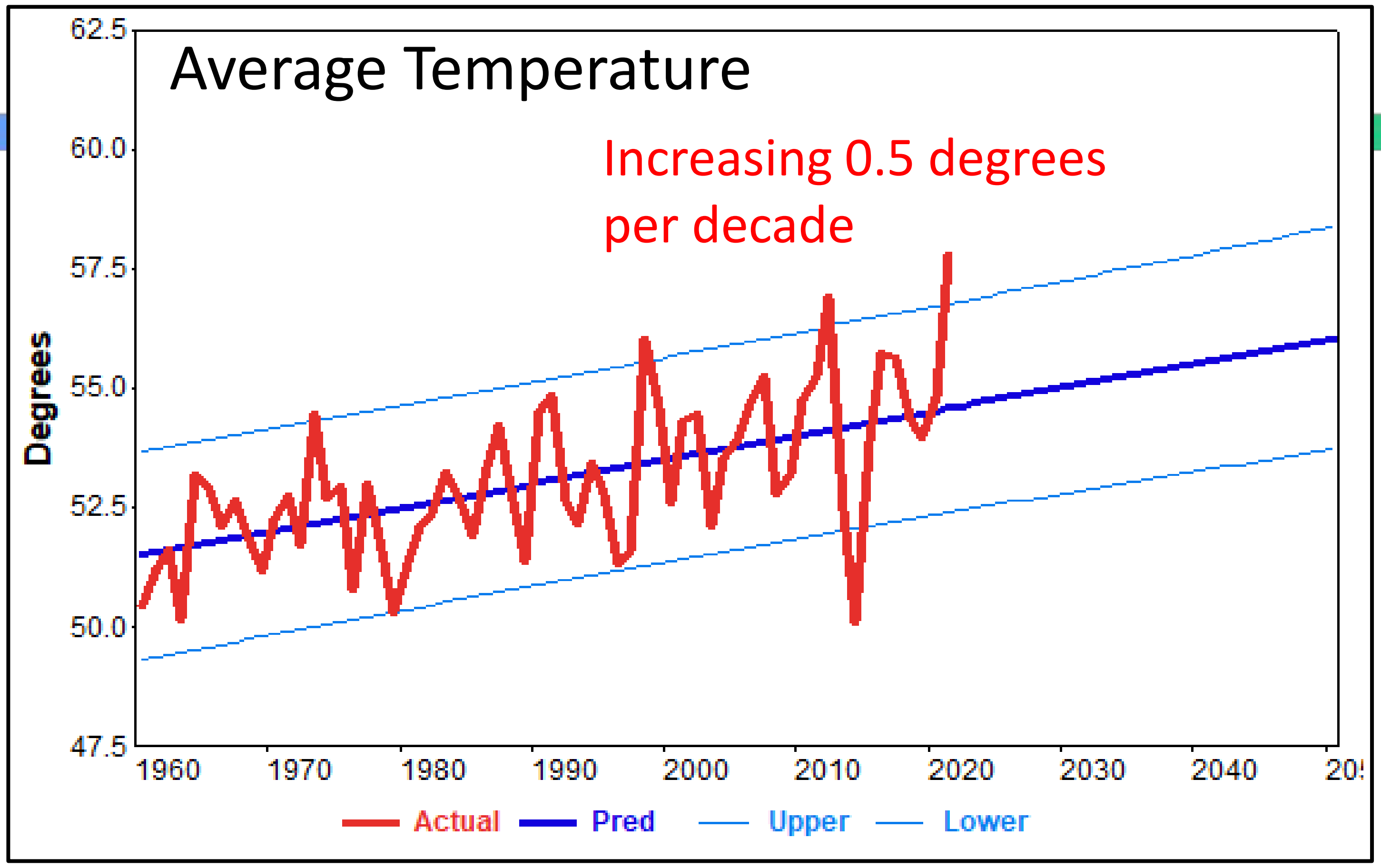
- →End-Use intensities (kWh per square ft) projected for 9 end-uses and 11 building types
- →Derived from EIA' Annual Energy Outlook (AEO) for East North Central Census Division.
- →Building-type intensities weighted to the AES service area based on AES commercial sales
- →Projected efficiency gains in lighting and ventilation have the largest impact on base use

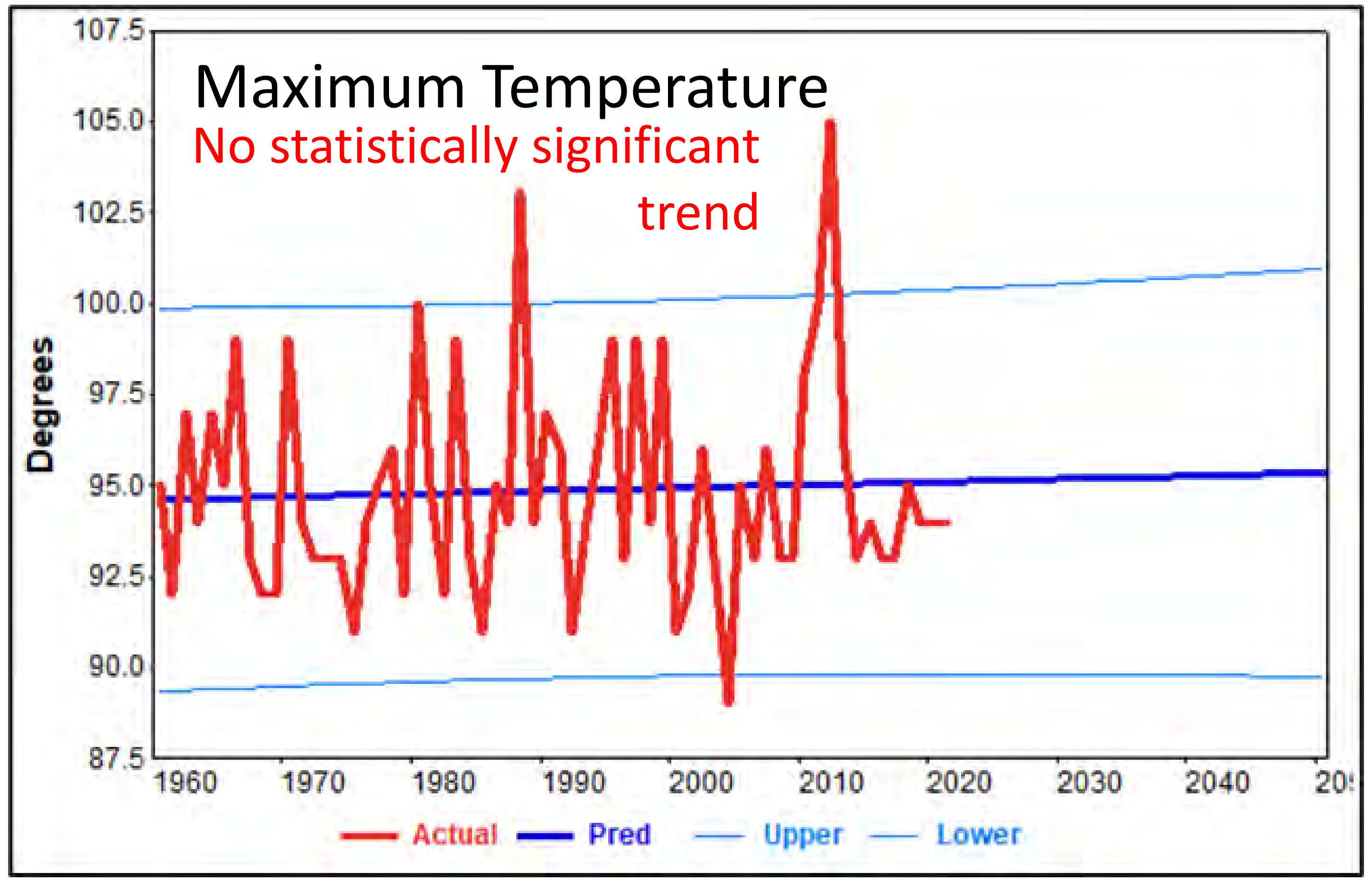


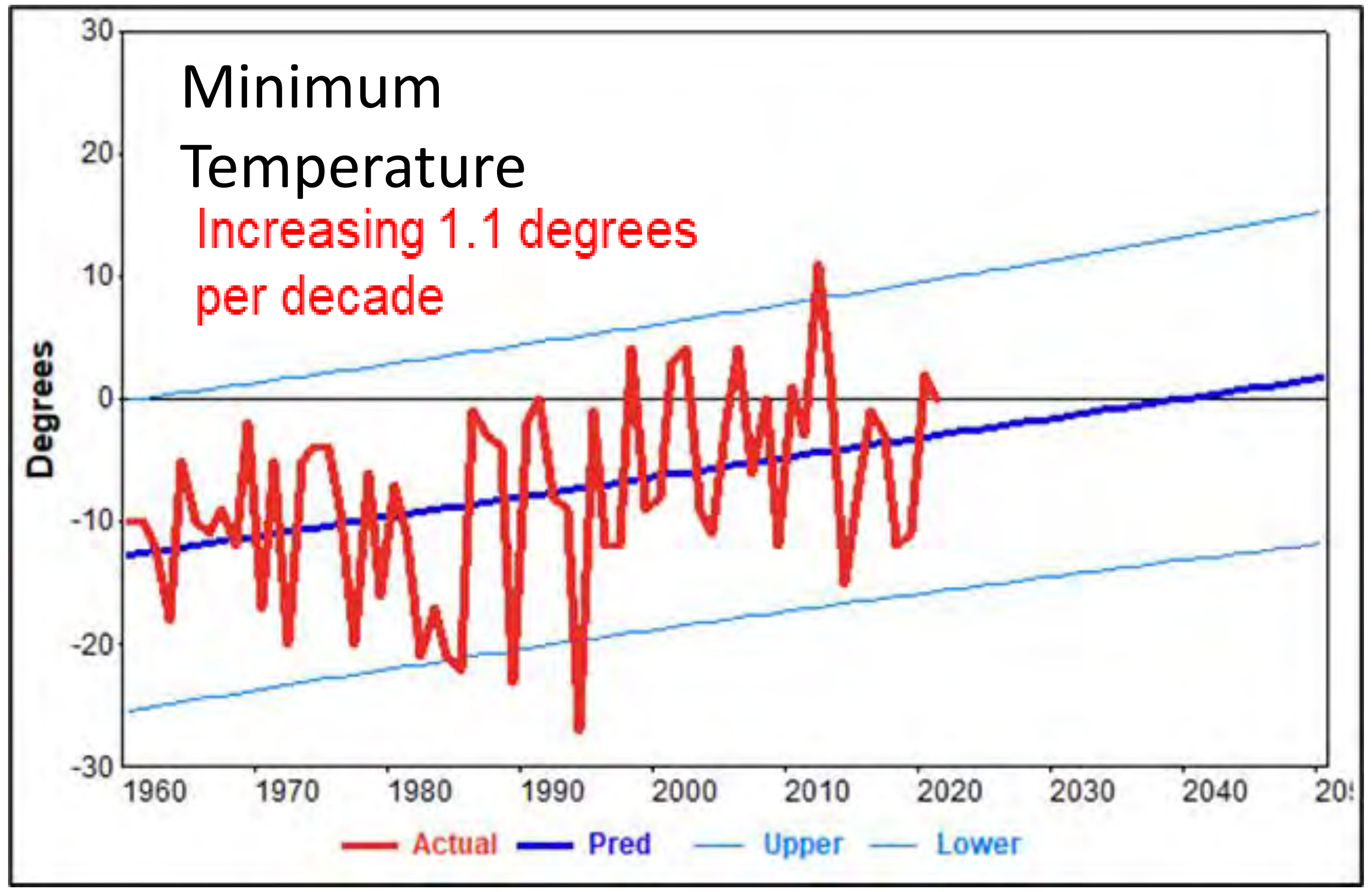
Avg. Annual Growth	
End-Use	Rate
Heating	-1.8%
Cooling	-0.1%
Base	-0.7%

Temperature Trends

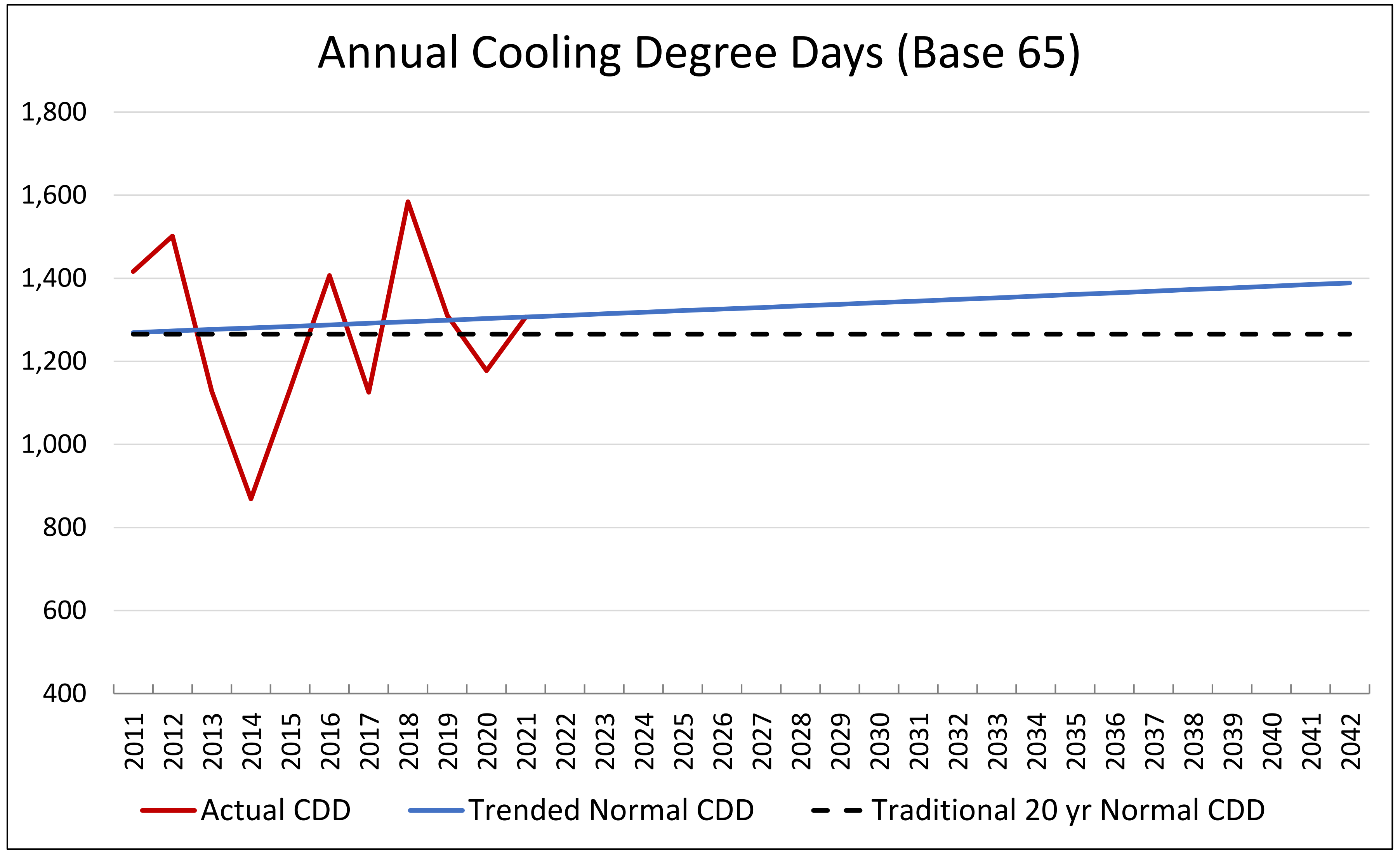
- → Average annual temperature is increasing .05 degrees per year or 0.5 degrees per decade.
- → Consistent with temperature trends across the country 0.4 degrees to 1.0 degrees per decade.
- → Minimum temperature increasing twice as fast as the average temperature. No increase in the maximum temperature.





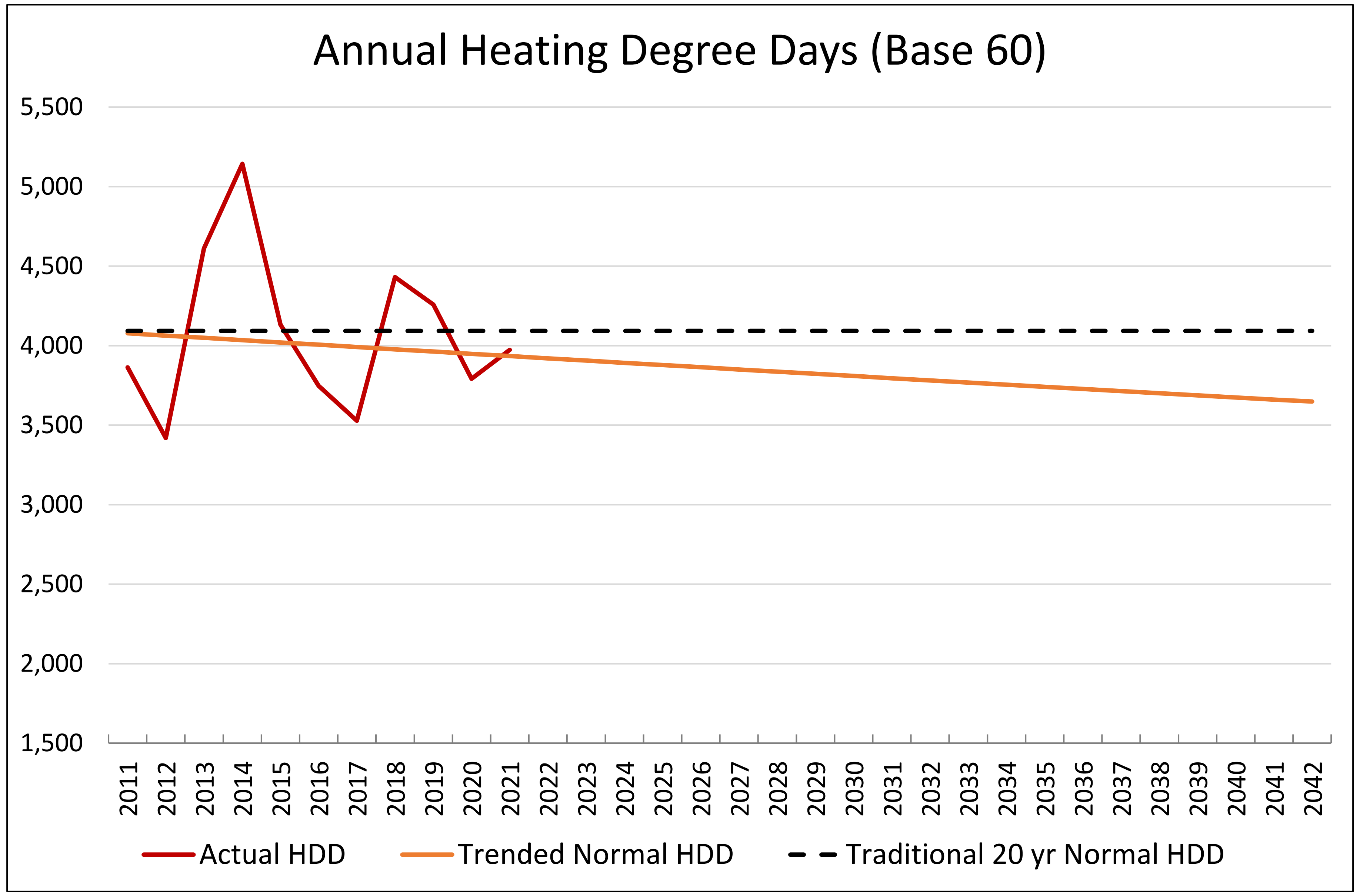


Trending Degree Days

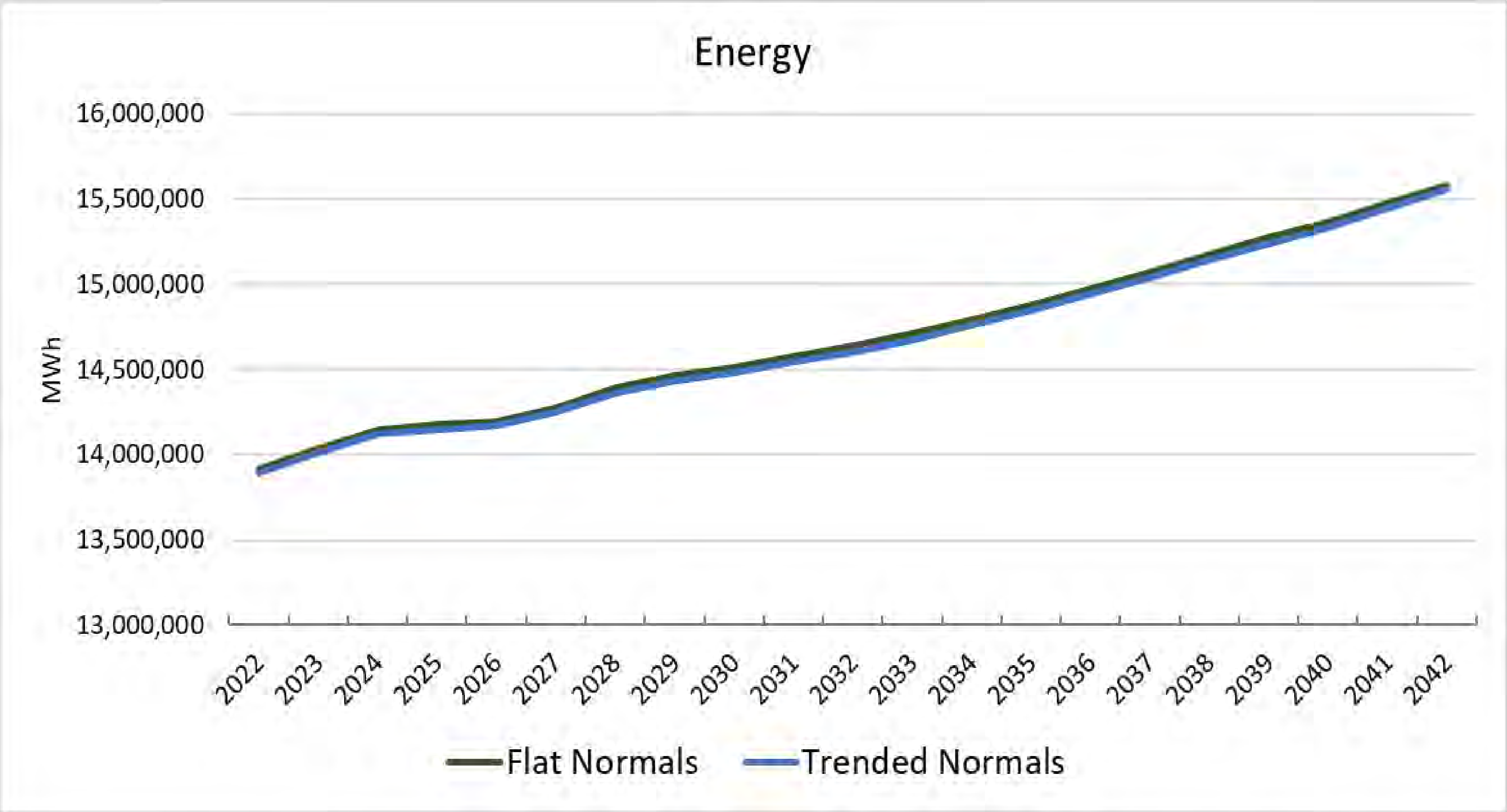


Increasing average temperature translates into 0.3% annual growth in cooling degree days.

And 0.4% annual decline in heating degree days.



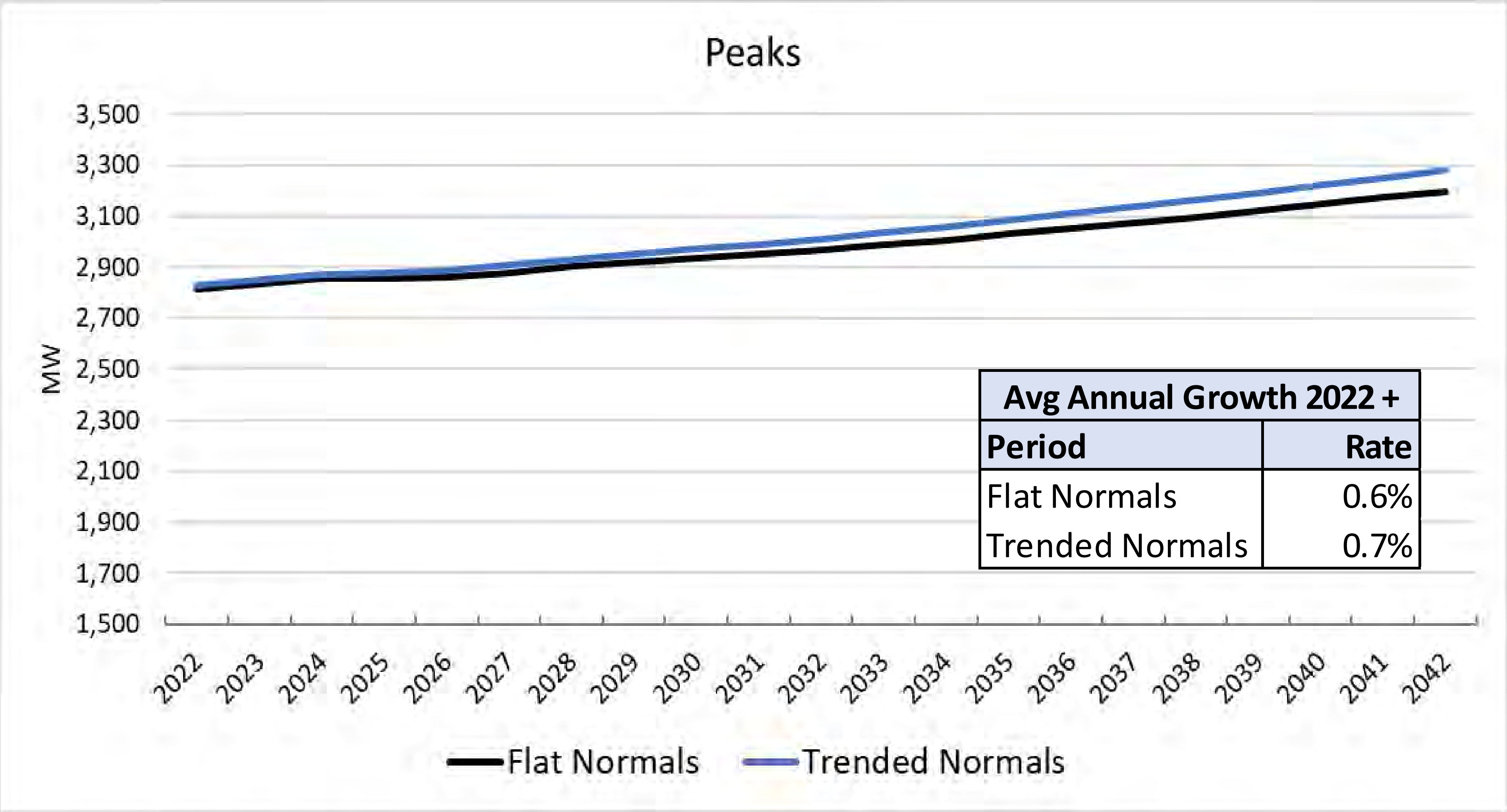
Impact of Increasing Temperatures



→Increasing temperatures contribute to cooling load growth in turn driving system peak demand.

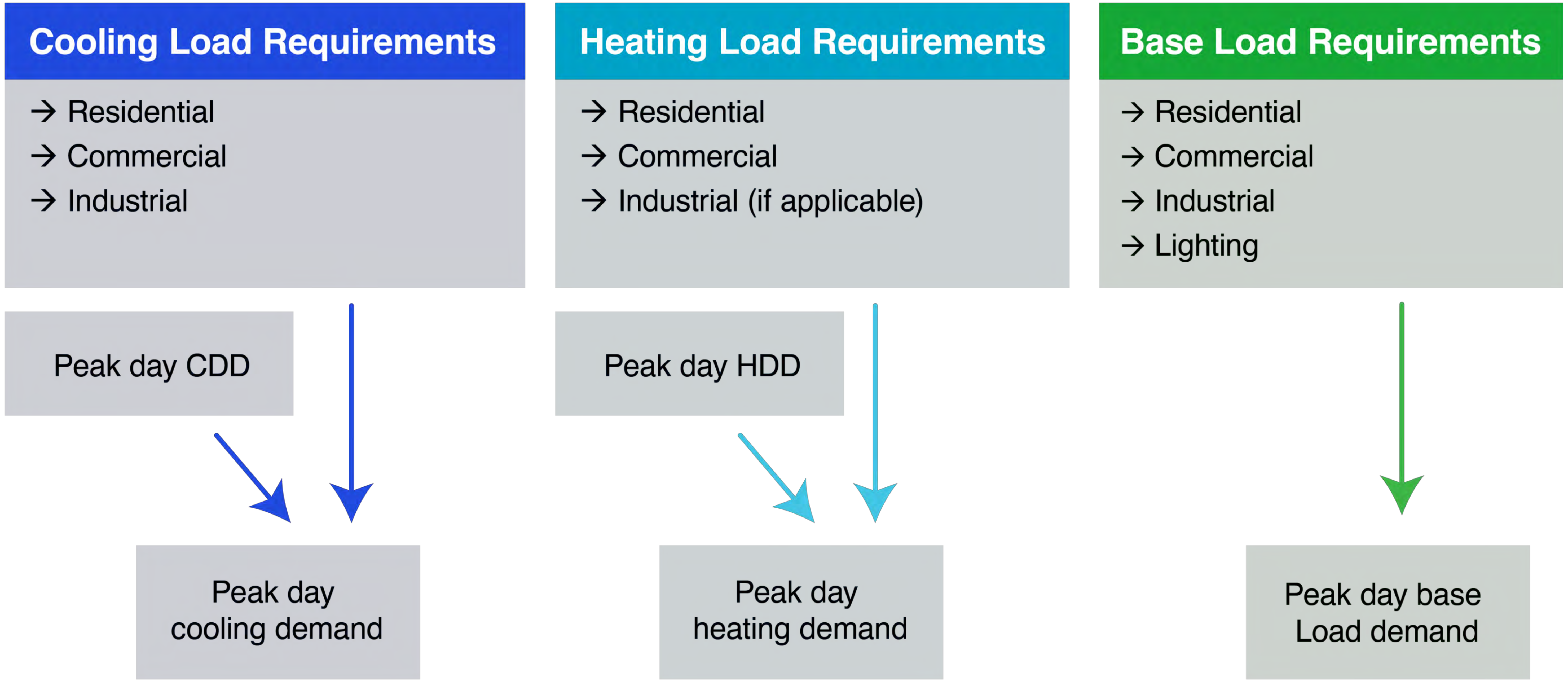
→0.05% annual temperature change contributes to 0.1% annual increase in baseline peak demand adding 82 MW by 2042.

→Little change in energy requirements as increase in cooling loads is offset by decrease in heating loads.



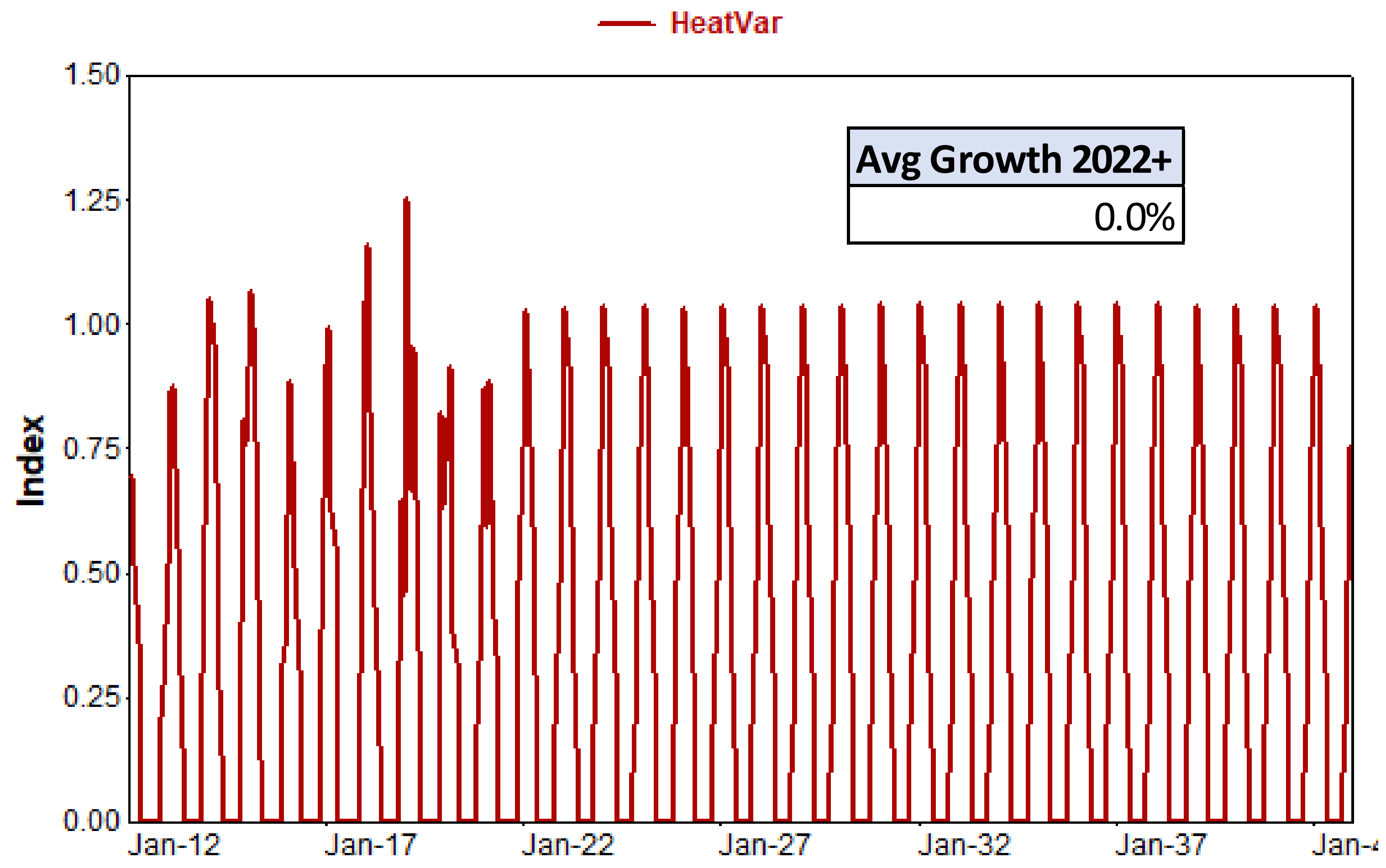
Peak Model

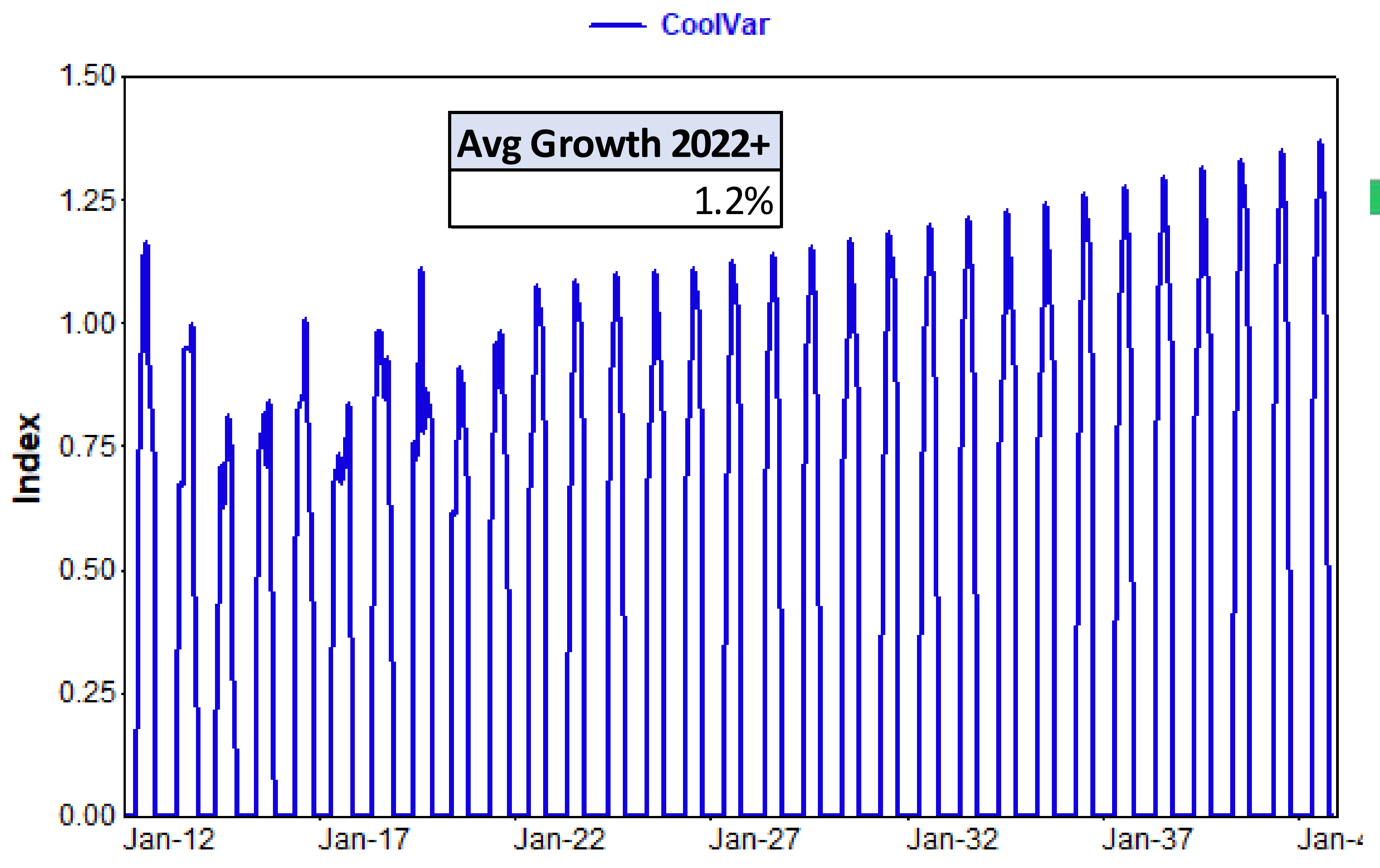
Peak demand is driven by heating, cooling, and base load requirements derived from the rate class sales forecast models.

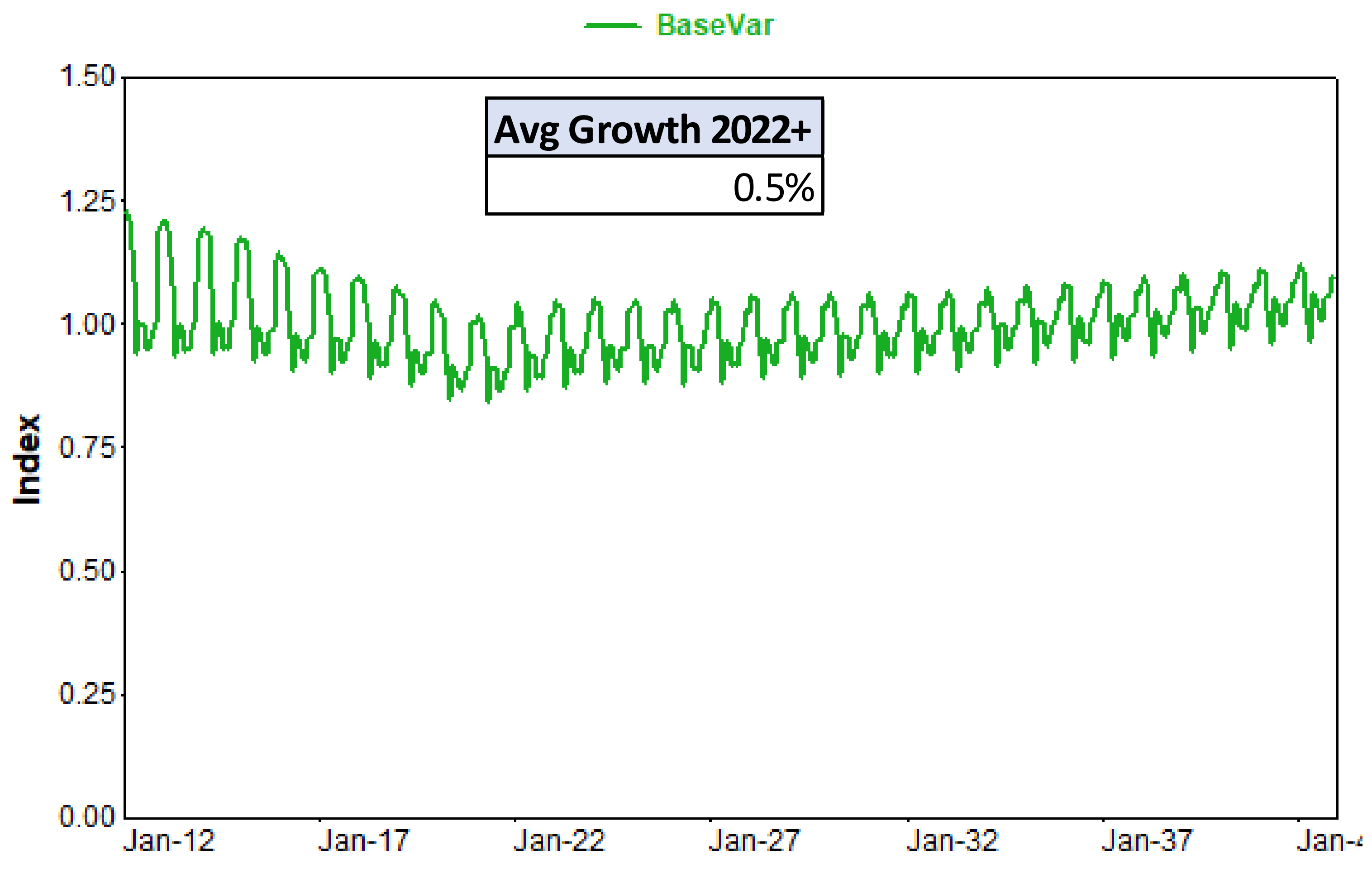


Itron aes Indiana

Peak Model Drivers





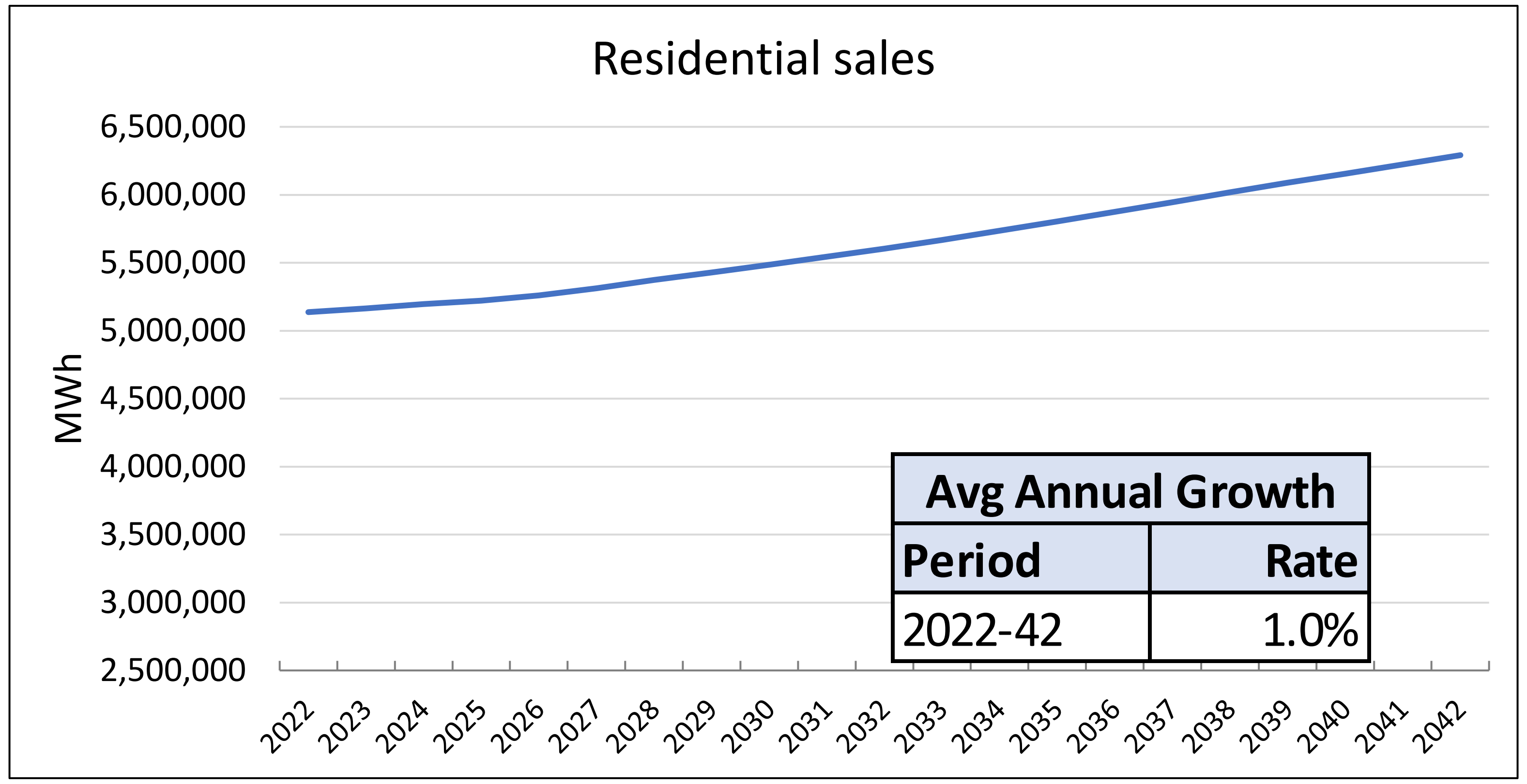


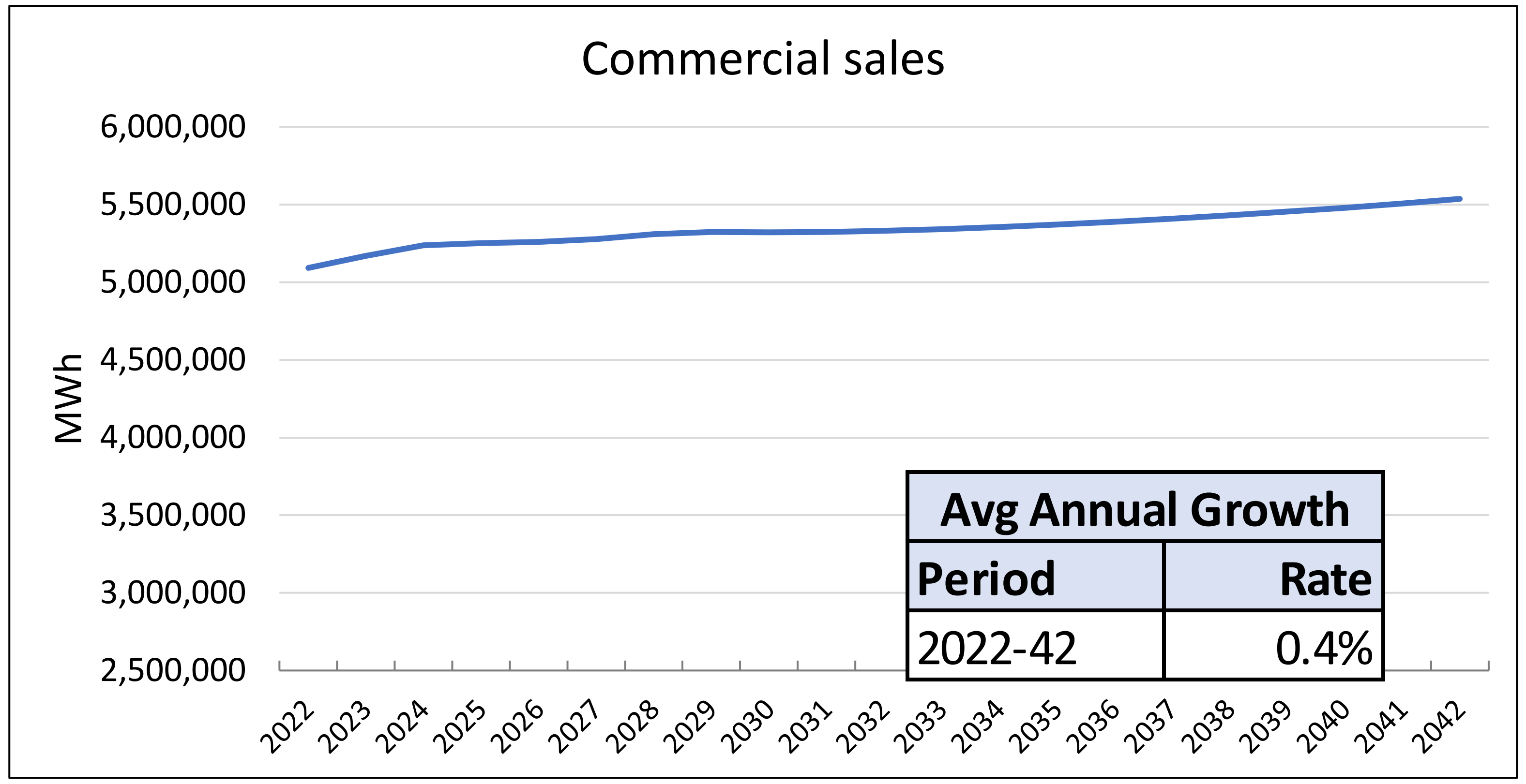
→ Heating, cooling, and base-use energy requirements derived from sales forecast models.

→ Base-use energy allocated to end-use coincident peak loads. Highest load in winter – lighting load.

Baseline Forecast

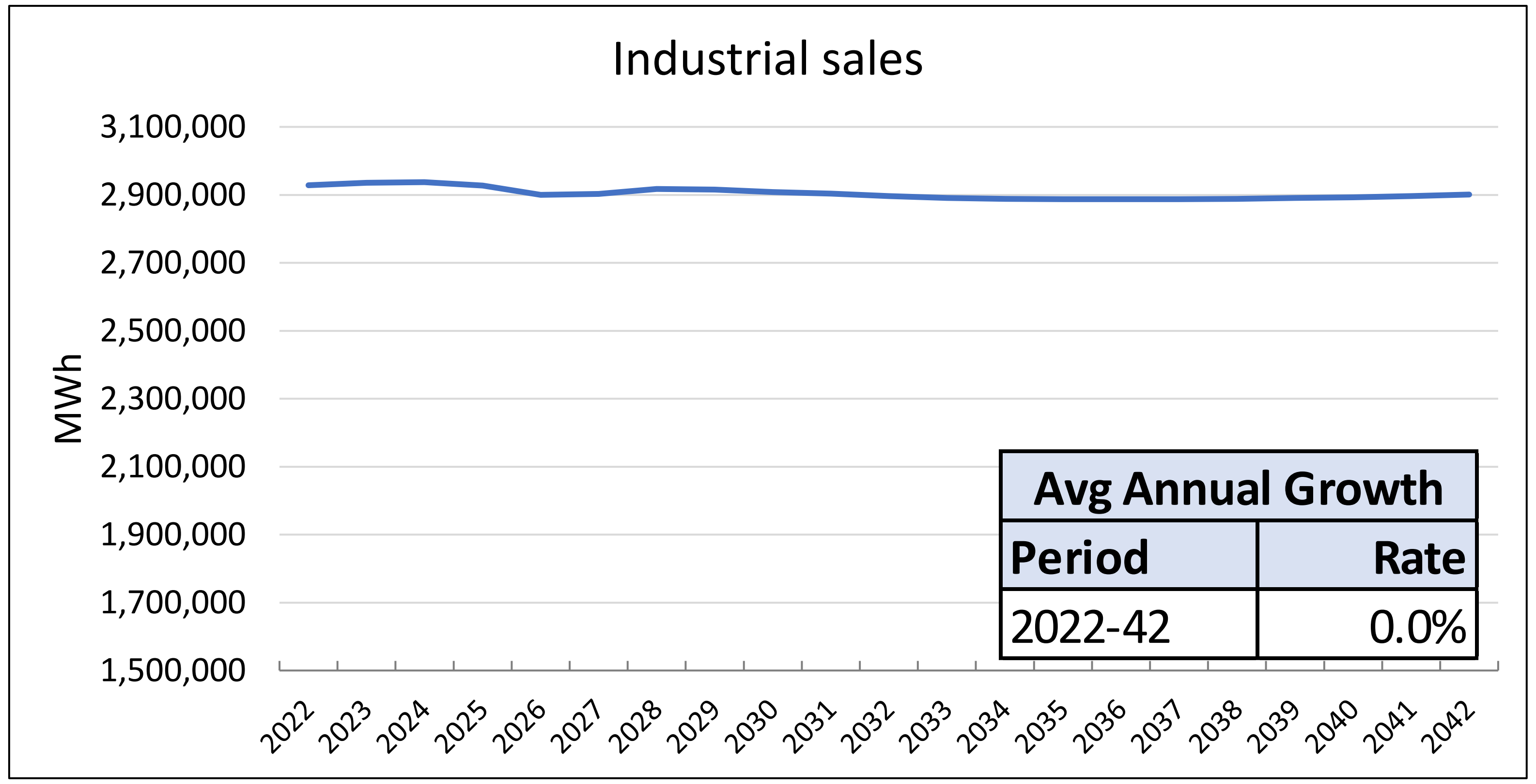
Baseline Class Sales Forecast



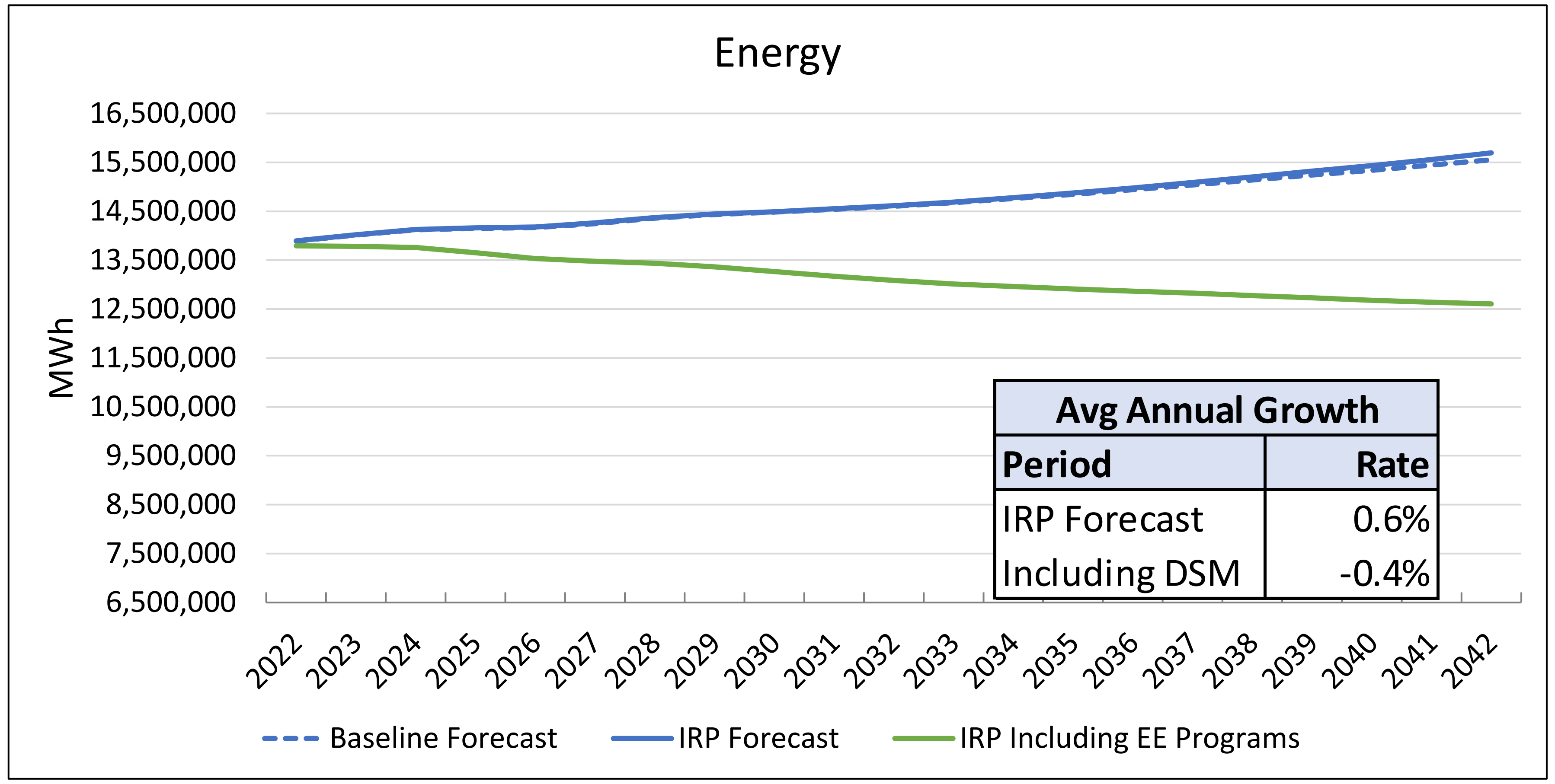


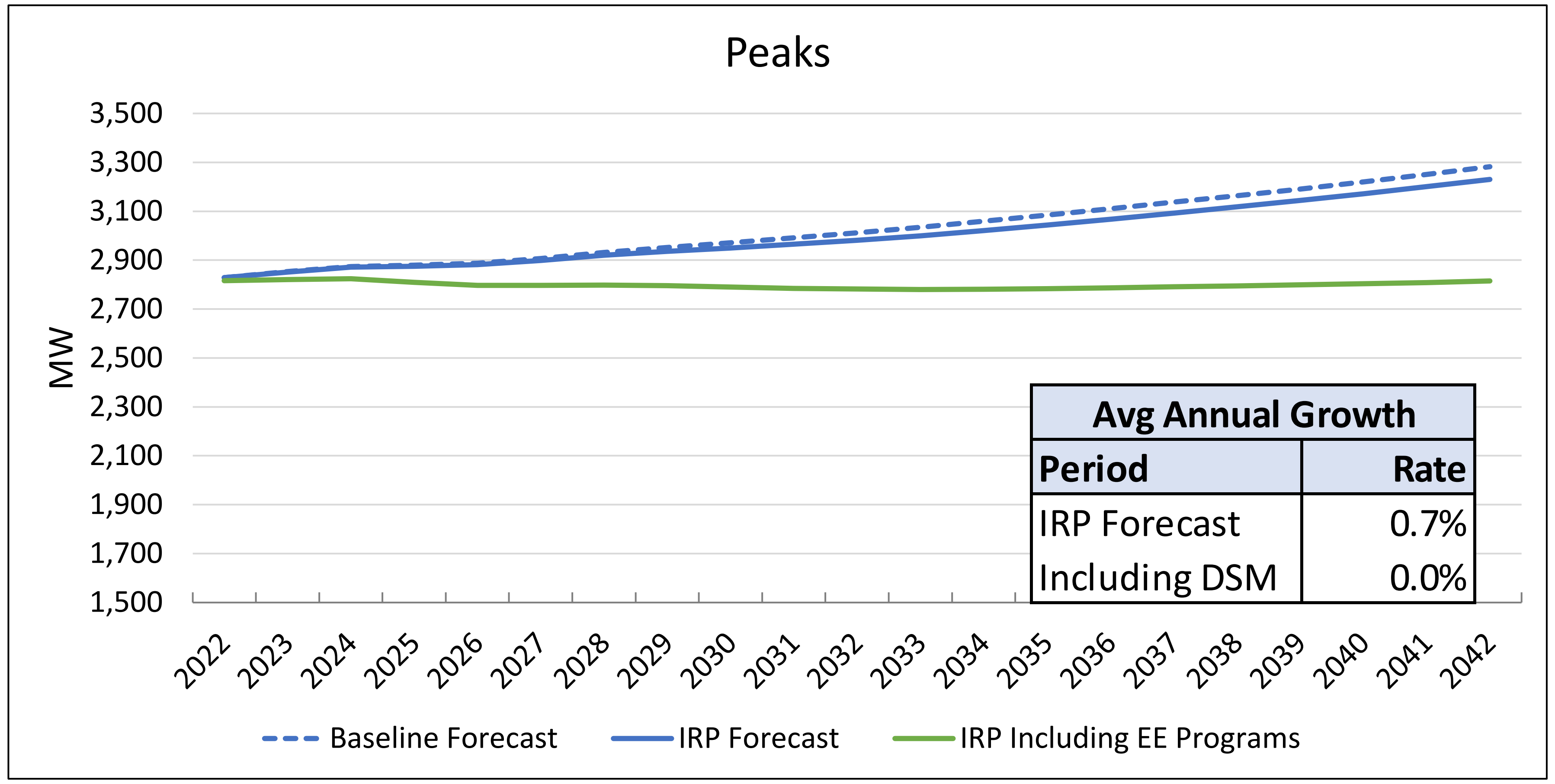
→Excludes

- Future Energy Efficiency Program savings
- Electric vehicle charging loads
- Future Behind-the-Meter solar adoption



Energy & Peak Forecast





- Baseline Forecast excludes energy efficiency programs (EE), electric vehicles, and solar impact
- IRP Forecast includes the impact of electric vehicles and solar but excludes EE
- Green line shows energy and peak demand with future EE continuing at current levels
  - With EE, energy and peak trend is consistent with the last ten-years

2022 Integrated Resource Plan (IRP)

Electric Vehicle (EV) and Solar PV Forecasts

Presented by IRP Partners

GDS Associates, Inc. ENGINEERS & CONSULTANTS

brightline GROUP

aes Indiana

Introduction to the GDS team

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

GDS will serve as the prime contractor for these studies. GDS is a privately-held multi-service engineering and consulting firm, with more than 175 employees. Our broad range of expertise focuses on clients associated with, or affected by electric, natural gas, water and wastewater utilities. GDS has completed over 75 energy efficiency and demand response potential studies over the last two decades. GDS also has significant experience in: Statistical & Market Research Services, Integrated Resource Planning, Load Forecasting Services, and Regulatory Support Services.

brightline
GROUP

Woman-owned collective of industry experts in DSM program planning and evaluation, with over 60 years of combined experience in the energy efficiency and engineering industry. Members of the Brightline Group has previously worked for GDS on I&M, Ameren Missouri, California POU, and Pennsylvania PUC evaluation and market research projects.

JEFFREY HUBER
Overall Project Manager & MPS Lead
GDS Associates

JACOB THOMAS
Market Research & End-Use Analysis Lead
GDS Associates

PATRICK BURNS
PV Modeling Lead & Regulatory/IRP Support
Brightline Group

MELISSA YOUNG
Demand Response Lead
GDS Associates

JORDAN JANFLONE
EV Modeling/Forecasting
GDS Associates

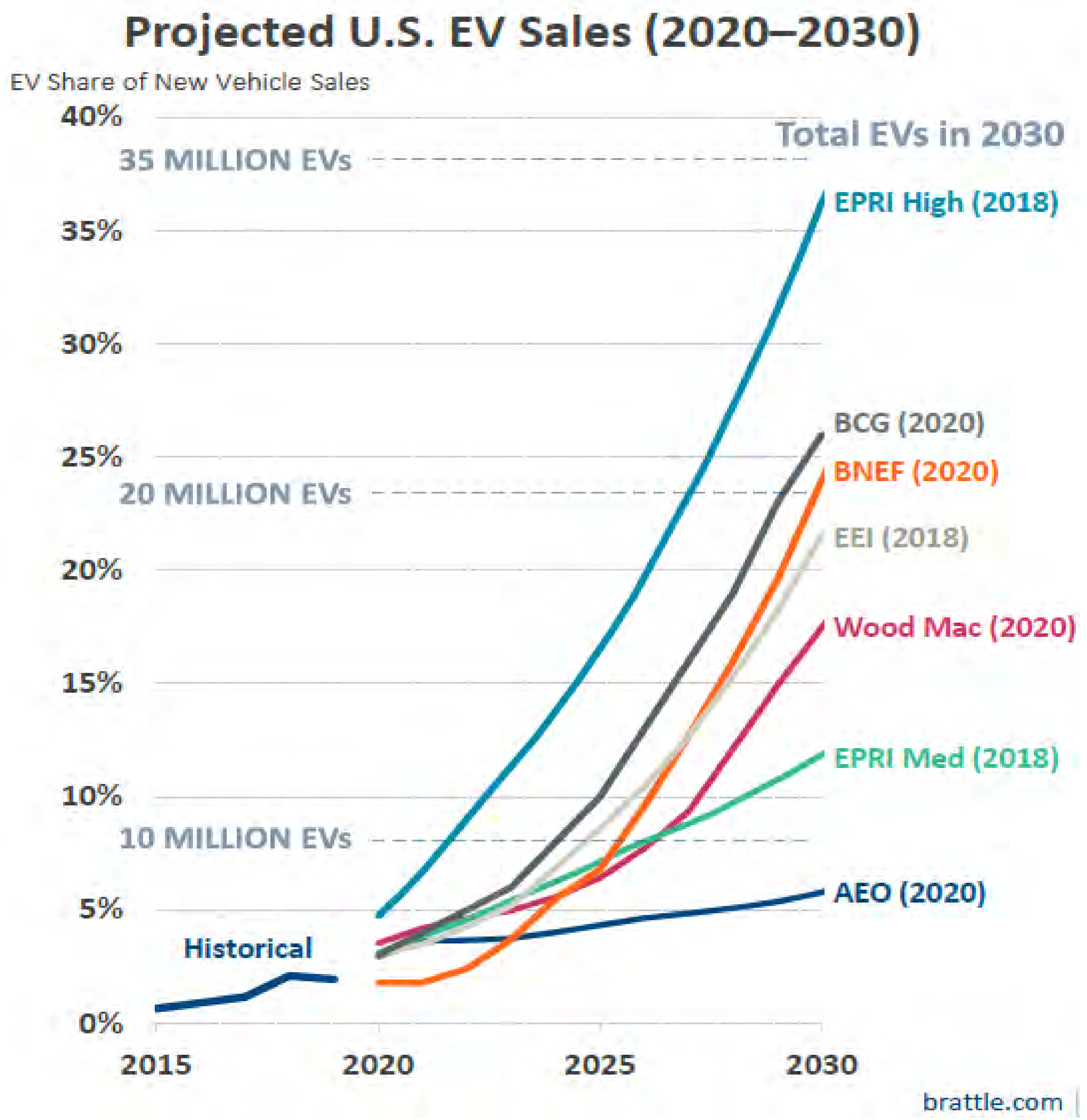
DSM Market Potential Study Introduction

Electric Vehicle (EV) / Solar PV Forecasts

Patrick Burns, PV Modeling Lead and Regulatory/IRP Support, Brightline Group
Jordan Janflone, EV Modeling Forecasting, GDS Associates

Residential Electric Vehicle Forecast

- →Goal is to forecast total number of EVs and resulting energy use in AES-IN service territory
- →Various assumptions are needed as inputs
- →Very broad ranges for EV penetration in the market, various sources have differing opinions and projections



GDS Associates, Inc. ENGINEERS & CONSULTANTS
brightline GROUP
aes Indiana

Residential Electric Vehicle Forecast

→EV Unit forecast informs EV Total Energy Forecast

→Similar process to a typical customer class forecast

Total number of EVs

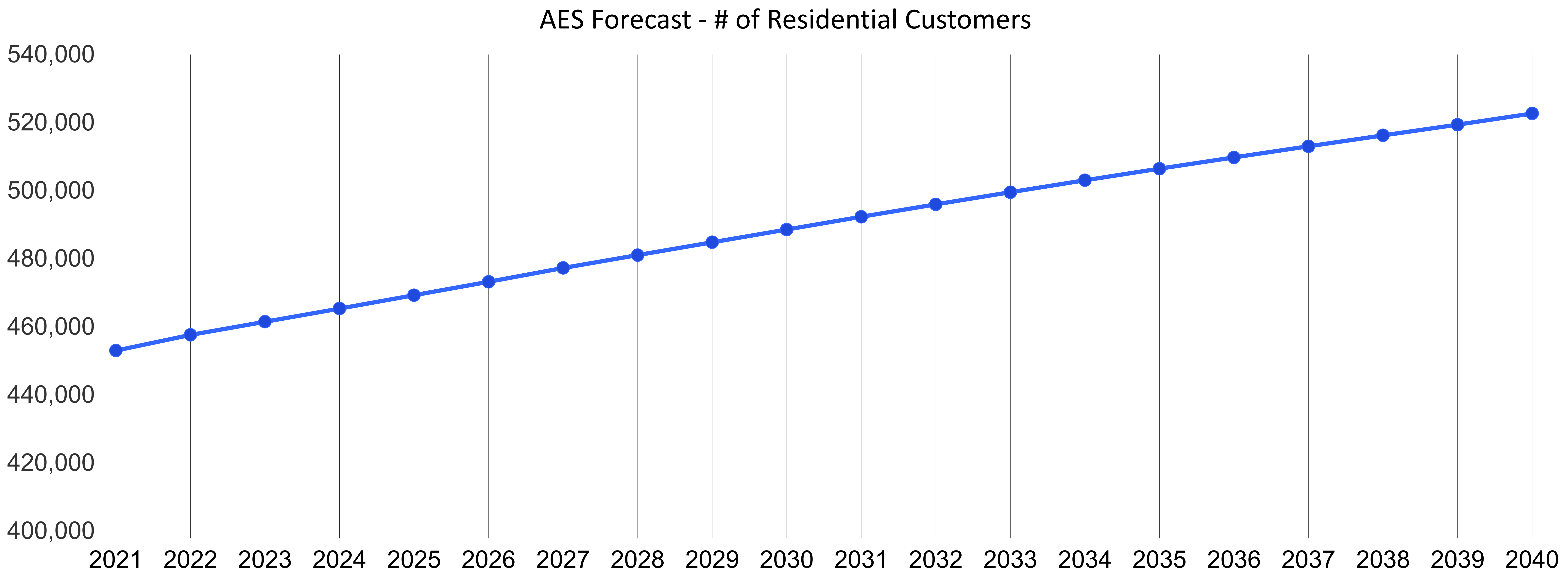
→

Total energy consumed by EVs

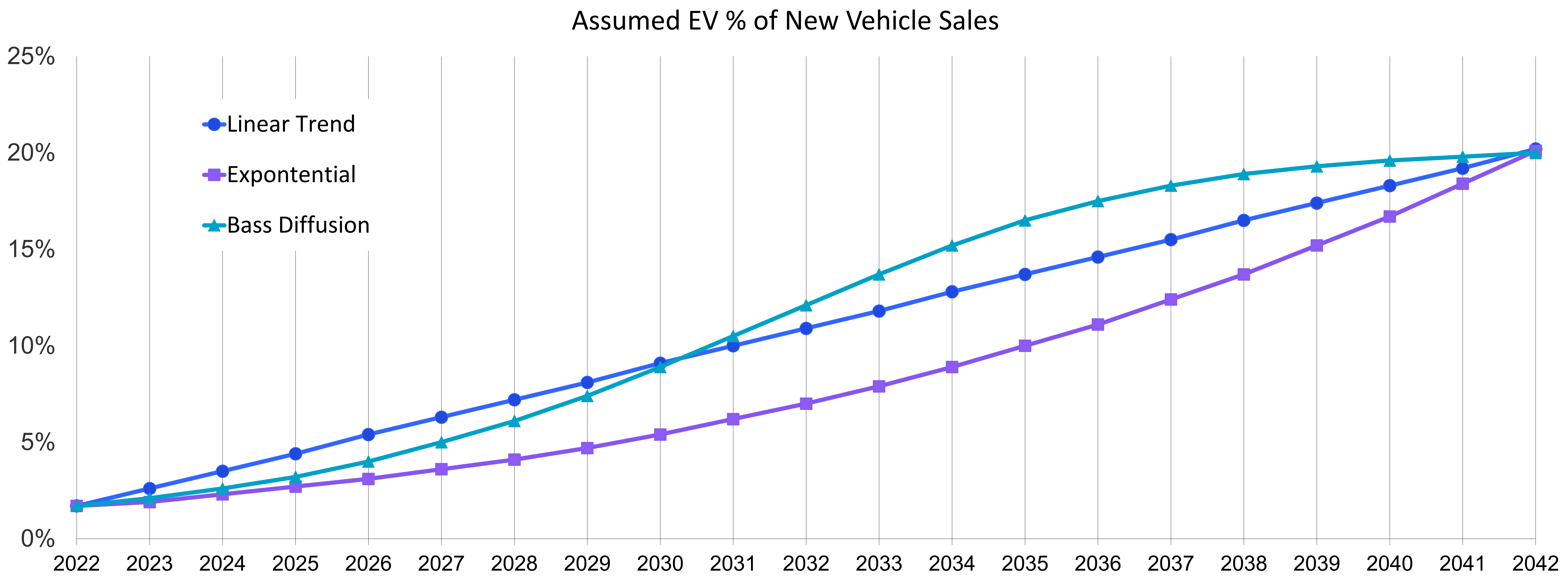
Residential Electric Vehicle Forecast

Input	Source
Number of residential customers	AES-IN Load Forecast
Average number of vehicles per household	U.S. Census – Indianapolis Metropolitan Area
Average vehicle life	U.S. Department of Transportation
Initial number of EVs	EV Registration data from AES-IN
Passenger car to light truck ratio	Energy Information Administration (EIA)
EV sales as percentage of total vehicle sales	Multiple scenarios and studies considered
Average kWh per mile	U.S. Department of Energy
Average miles per year driven by EV	Car & Driver EV Owner Study

Residential Customer Forecast

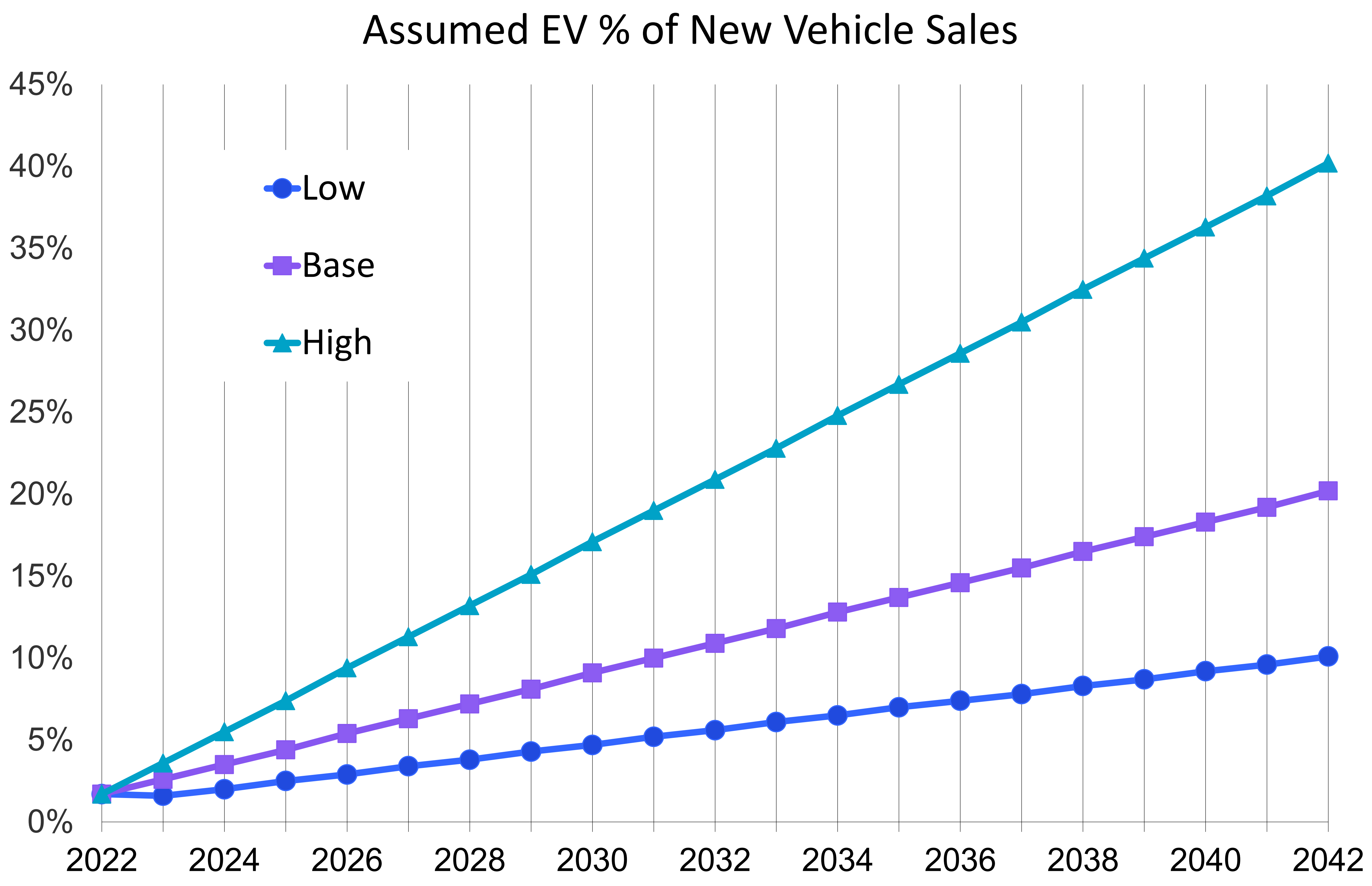


EV Sales Trend Forecast



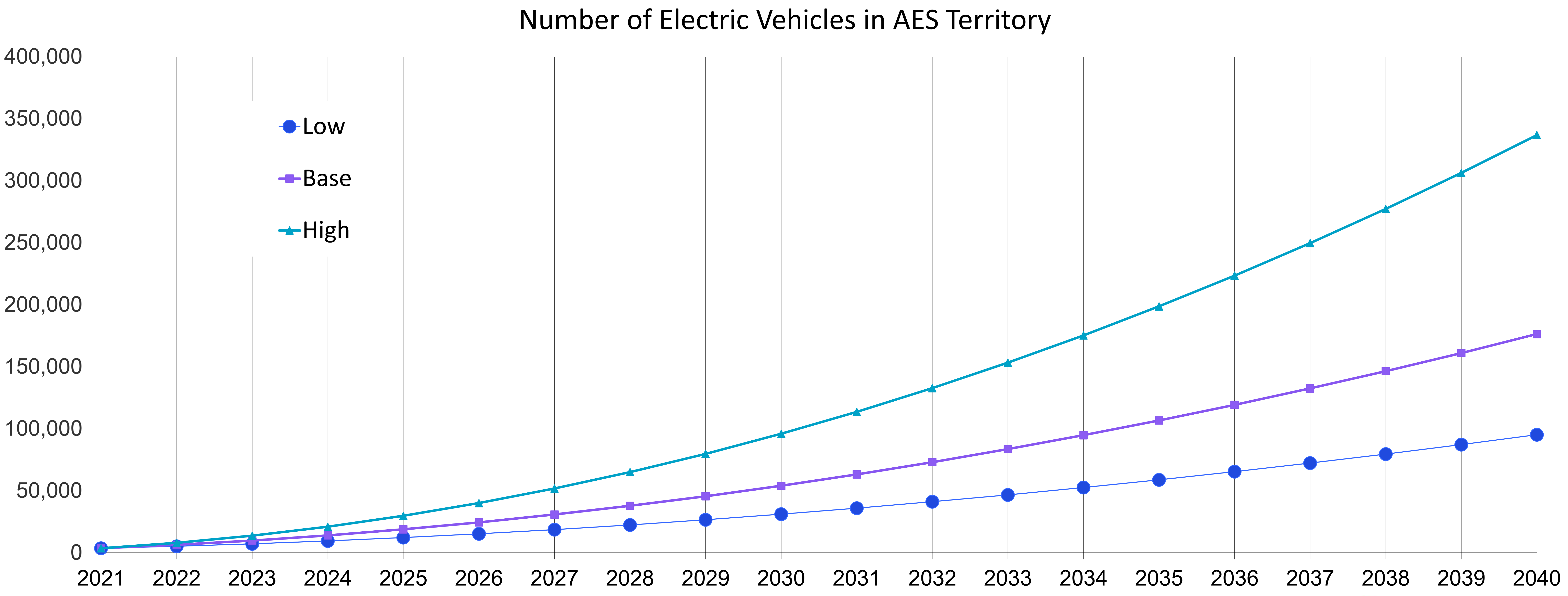
EV Sales Scenarios

- →Linear trend was selected for scenario modeling
- →EIA uses a linear trend sales trend
- →3 trend scenarios were modeled
  - → Low projections are similar to current EIA forecast
  - → Medium aligns with a blend of the BCG and EPRI medium projections
  - → High projections are similar to EPRI High.



GDS Associates, Inc. ENGINEERS & CONSULTANTS
brightline GROUP
aes Indiana

EV Sales Scenarios



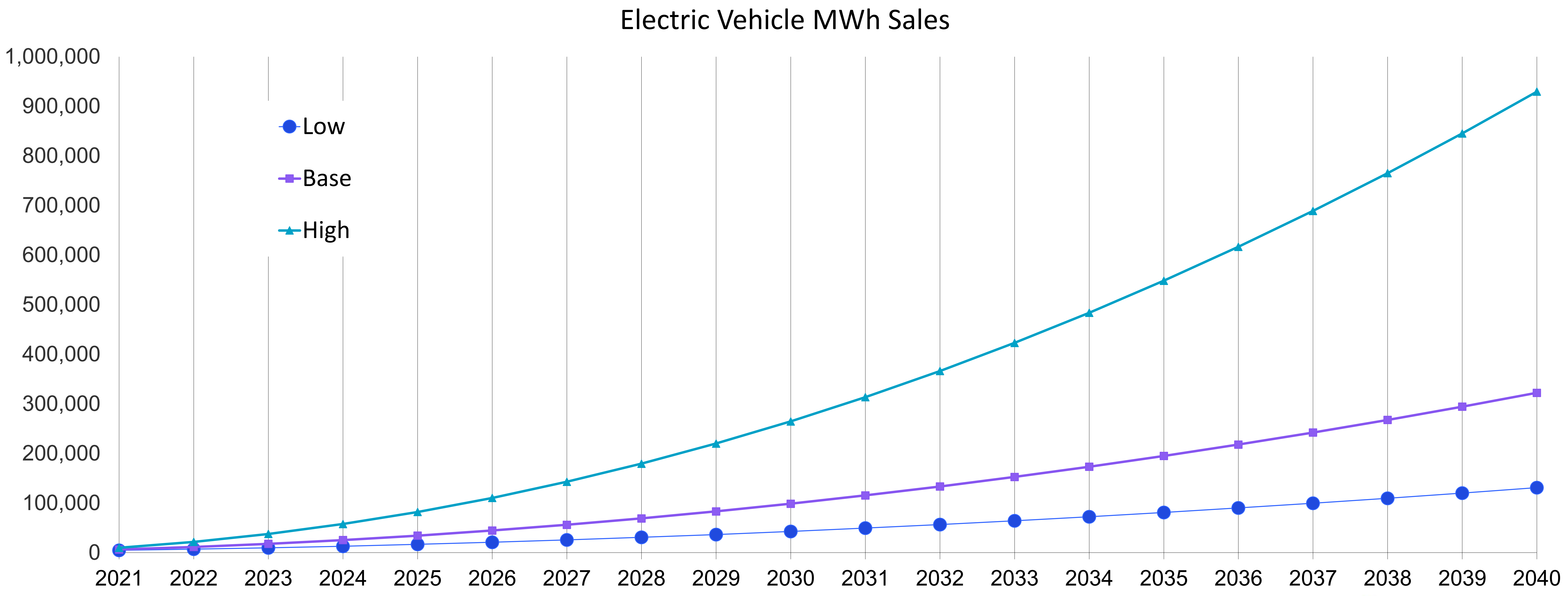
GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

Electric Vehicle Energy (MWh) Forecast

- Energy is a function of total EV units, average kWh/mile, and total number of miles/year/EV
- 3 trend scenarios were modeled
  - Low, Base, High

Input	Base	High	Low
Number of Vehicles in 2021	3,575	3,575	3,575
% of EV Sales in 2030	11%	21%	6%
% of EV Sales in 2040	20%	40%	10%
Miles/year/vehicle	5,300	8,000	4,000
Average kWh/mile	0.345	0.345	0.345

EV Energy (MWh) Forecast

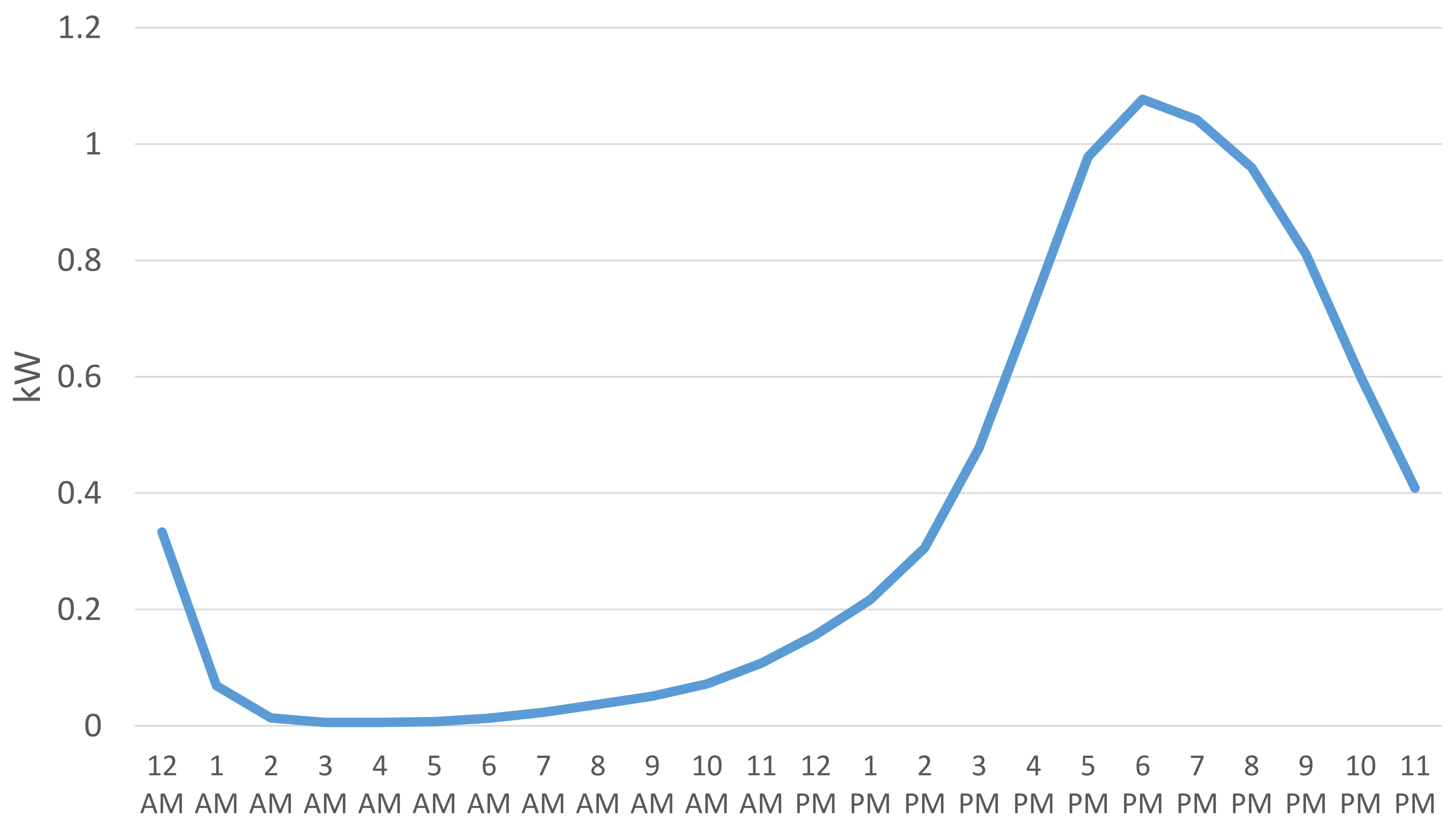


GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

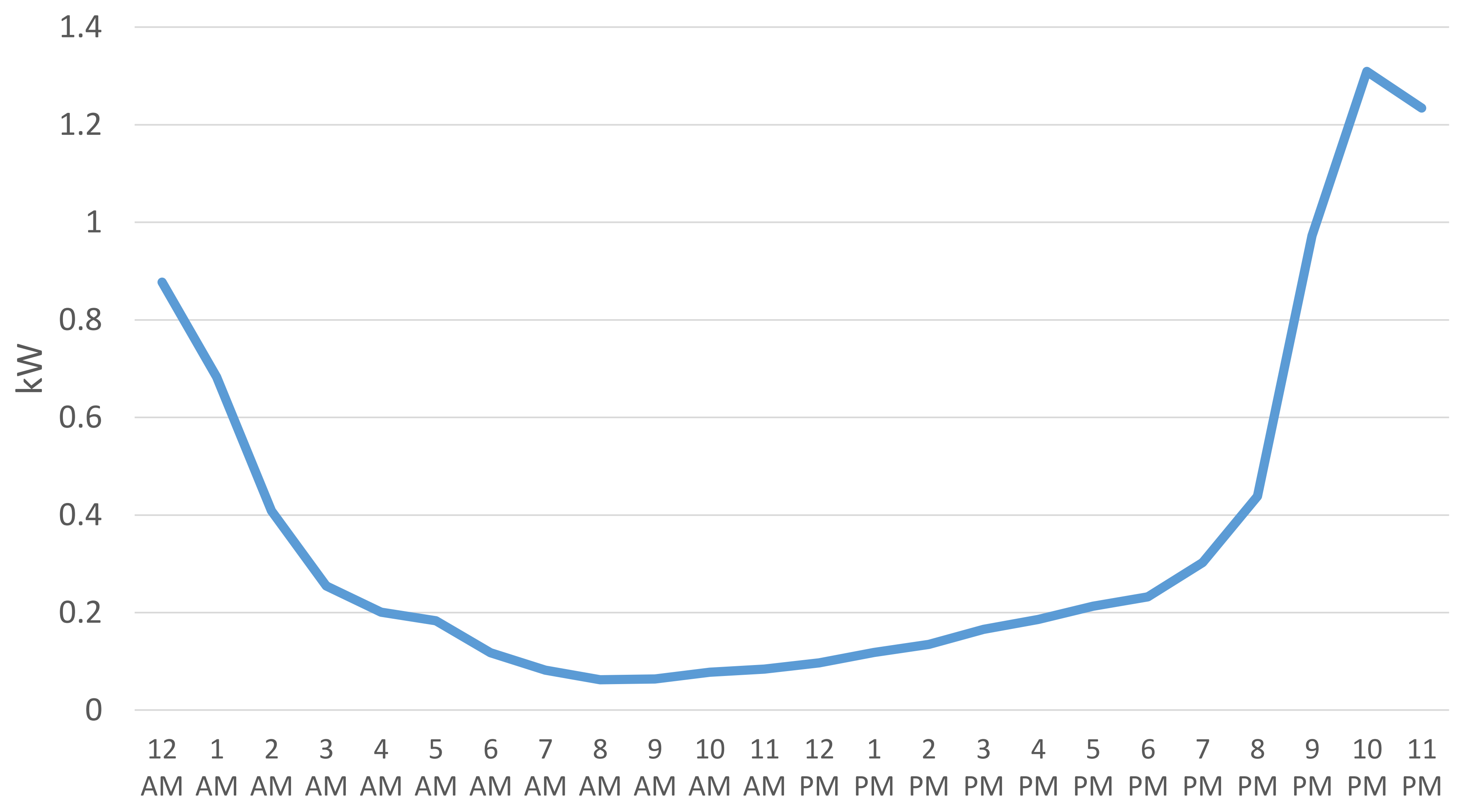
Residential Electric Vehicle Load Shape

→ Load shapes for electric vehicles come from:
  - → Non-managed Charging – Guidehouse which uses a blend of utility EV metering programs and synthetic datasets from US National Labs
  - → Managed Charging – AES Indiana AMI data from EVX customers

Weekday: Non-managed Customer Profile



Weekday: Managed Customer Profile



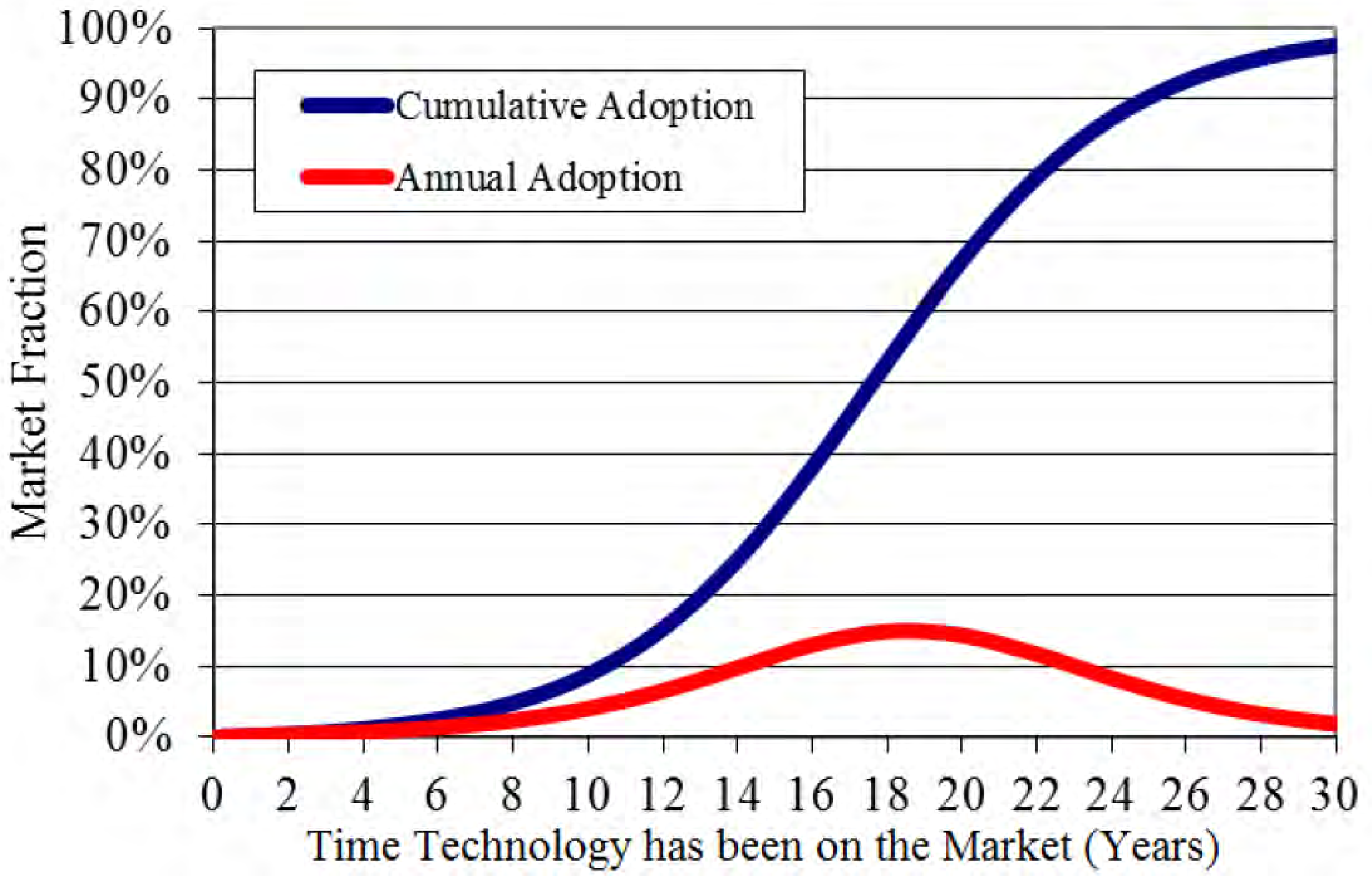
GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

PV Preliminary Forecast

Forecast Framework – Bass diffusion model

→Key parameters:

- → Existing market share
- → Maximum market share
- → Coefficients of innovation (p) and imitation (q)



GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

PV Preliminary Forecast – Bass model parameters

- →Existing market share:
  - → AES IN 2021 Q3 cumulative net metering data
    - 625 existing residential systems
    - 46 existing non-residential systems
- → Maximum market share:
  - → AES IN customer forecast
  - → PV technical constraint factor
    - 48% residential; 79% non-residential
    - Based on NREL NSRDB data which accounts for constraints such as shading, contiguous roof area, panel orientation, etc.
- → Coefficients of innovation (p) and imitation (q):
  - → NREL dGen model (based on state-level EIA DGPV interconnection and Census data)

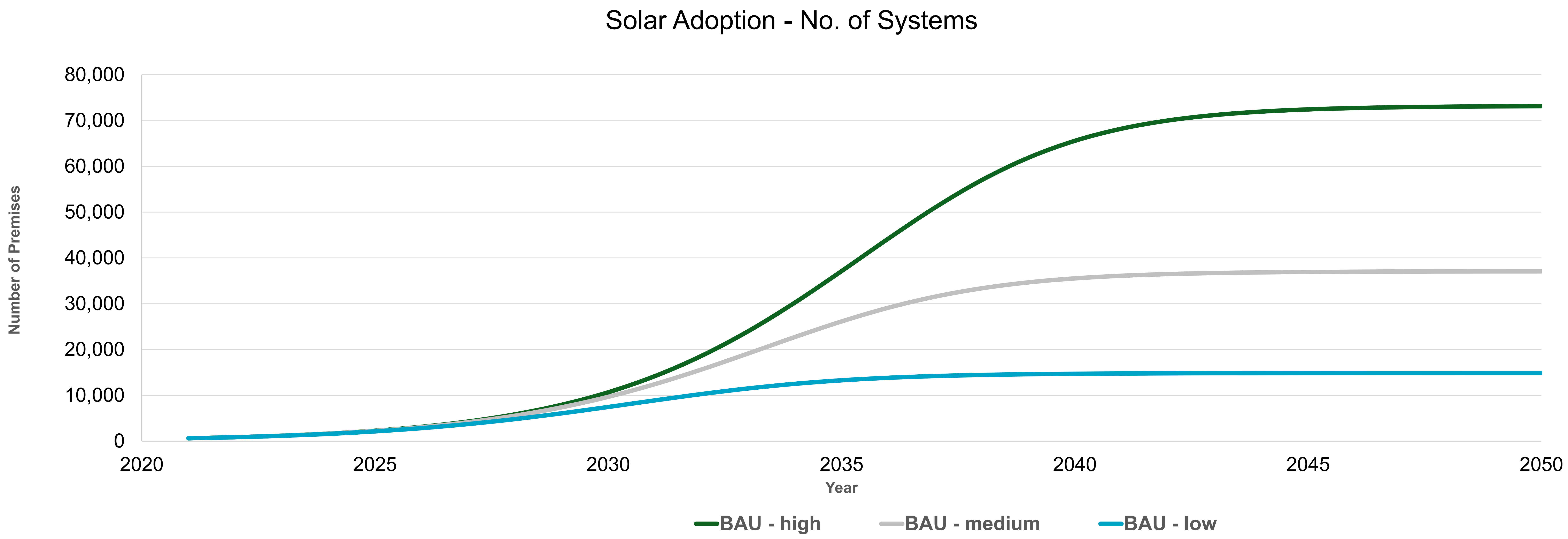
PV Preliminary Forecast – Scenario Analysis

3 Business-As-Usual (BAU) Scenarios Considered

- →Scenarios based on adoption probability:
  - → Currently estimated based on CAGR of historically installed systems within AES IN territory and regional customer WTP survey data
  - → Will be updated based on findings from AES IN market research
- →Residential:
  - →High: 29% market adoption
  - →Medium: 15% market adoption
  - →Low: 6% market adoption
- →Non-Residential:
  - →High: 35% market adoption
  - →Medium: 19% market adoption
  - →Low: 7% market adoption

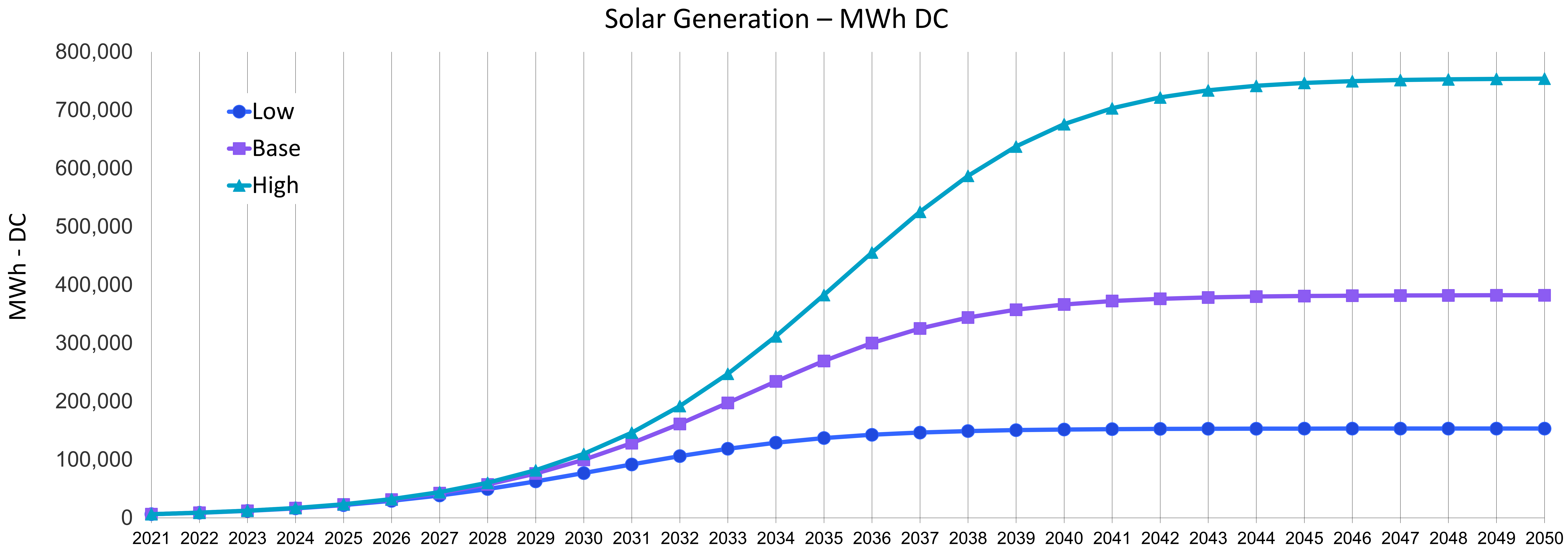
PV Preliminary Forecast

Model forecast results – Residential



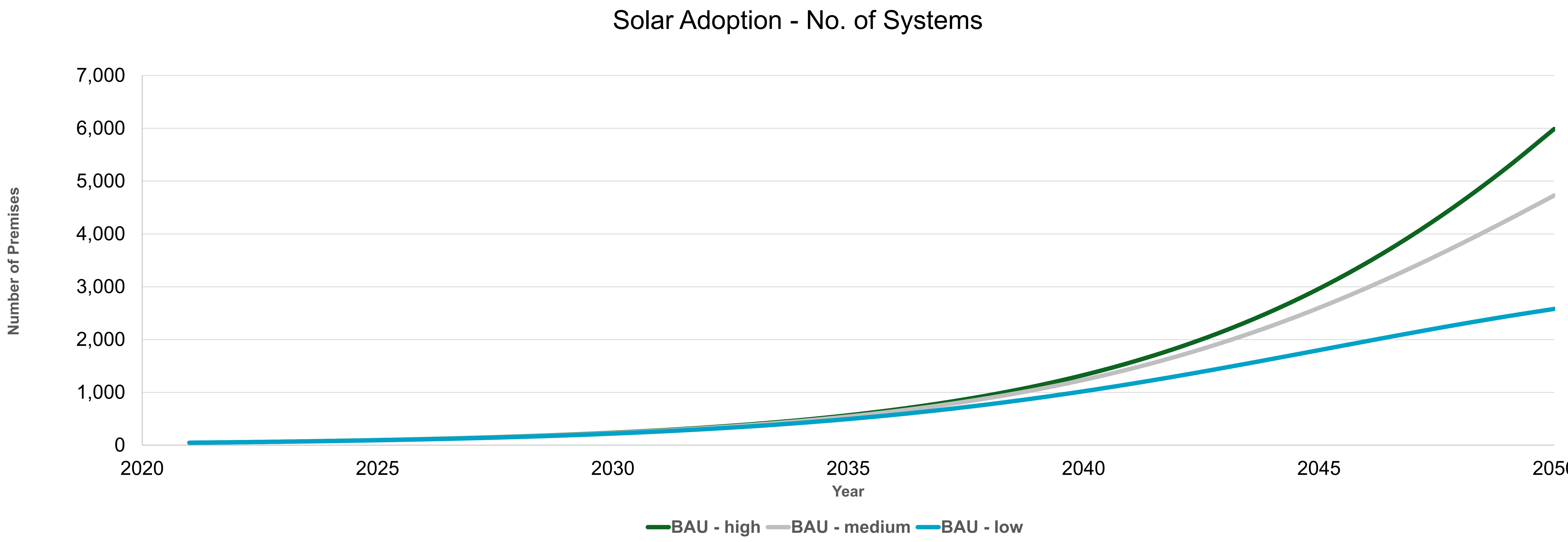
PV Preliminary Forecast

Model forecast results – Residential



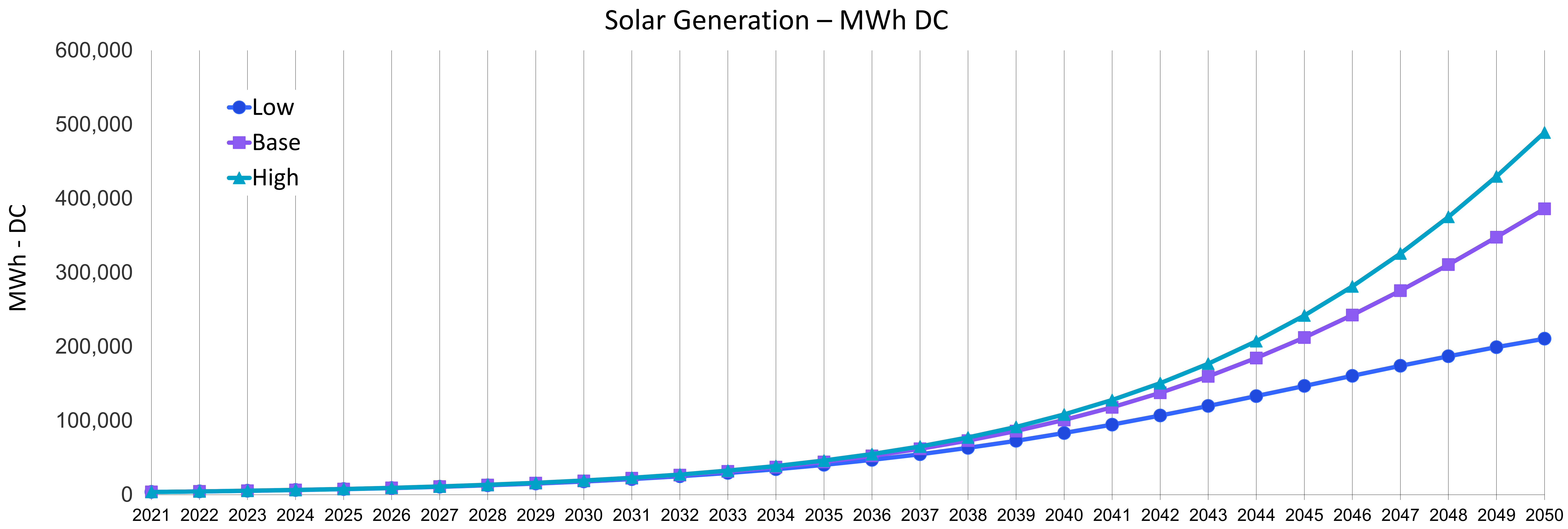
PV Preliminary Forecast

Model forecast results – Non-Residential



PV Preliminary Forecast

Model forecast results – Non-Residential

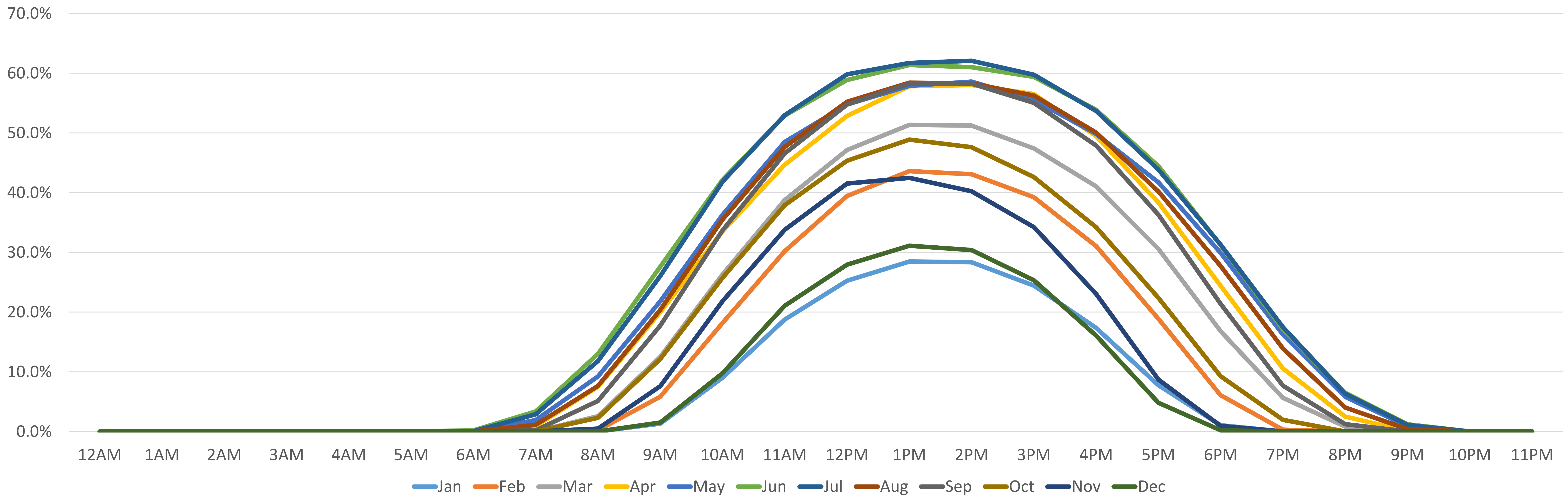


GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

PV Load Shape

→Load shapes for solar come from:

→ Residential customer AMI data for ground (50%) and roof (50%) solar installations



2022 Integrated Resource Plan (IRP)

DSM Market Potential Study Introduction

Presented by IRP Partners

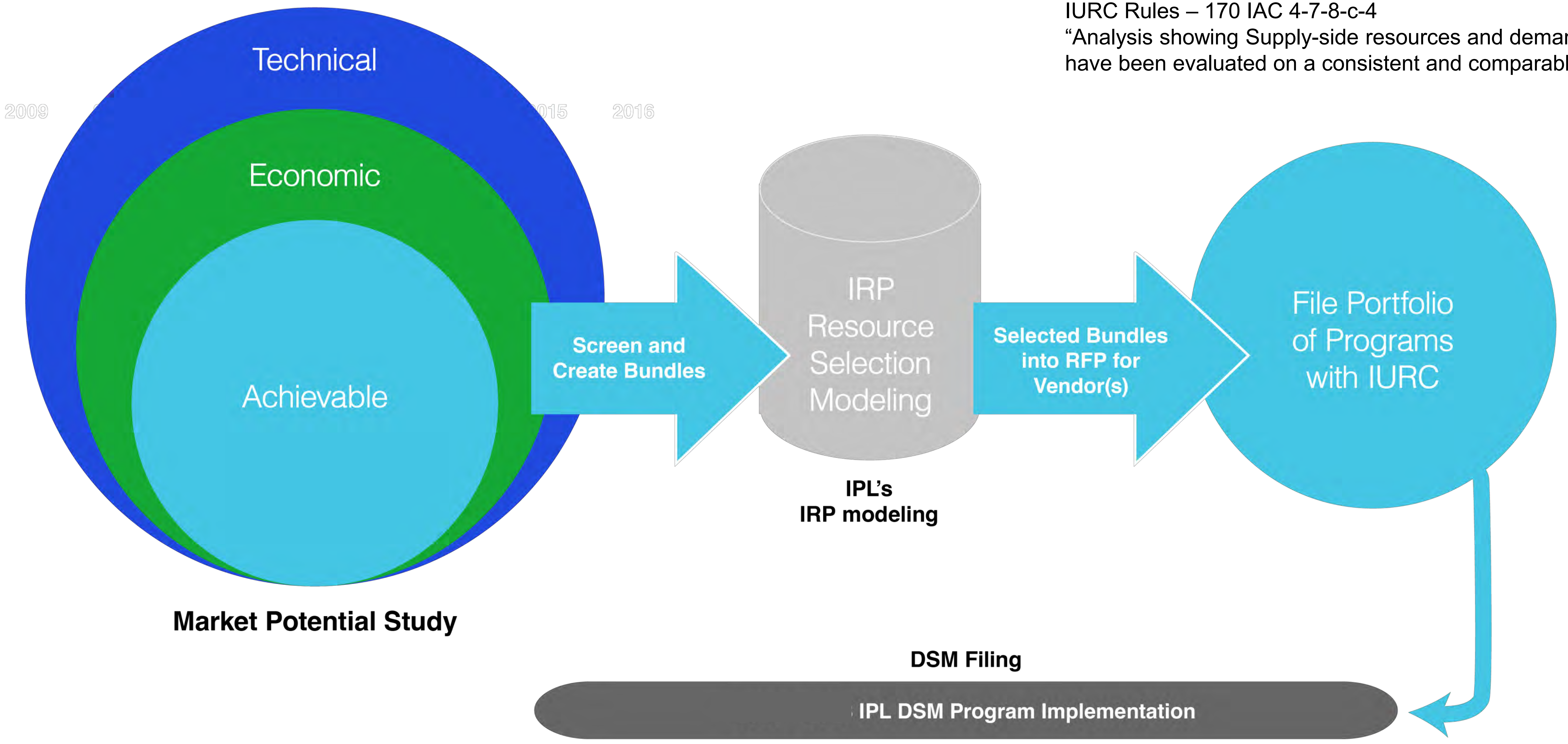
GDS Associates, Inc. ENGINEERS & CONSULTANTS

brightline GROUP

aes Indiana

Introduction to the DSM Process in the IRP

IURC Rules – 170 IAC 4-7-8-c-4
“Analysis showing Supply-side resources and demand-side resources have been evaluated on a consistent and comparable basis.”



aes Indiana

Agenda

- → Overview
  - Team Introduction
  - Purpose of a Market Potential Study (MPS)
  - MPS/IRP Related Work
- → Market Research
  - End-Use Analysis
  - Willingness to Participate in DSM Programs
- → Energy Efficiency (EE) Potential
- → Demand Response (DR) Potential
- → Initial EV/PV Forecasts

Introduction to the GDS team

GDS will serve as the prime contractor for these studies. GDS is a privately-held multi-service engineering and consulting firm, with more than 175 employees. Our broad range of expertise focuses on clients associated with, or affected by electric, natural gas, water and wastewater utilities. GDS has completed over 75 energy efficiency and demand response potential studies over the last two decades. GDS also has significant experience in: Statistical & Market Research Services, Integrated Resource Planning, Load Forecasting Services, and Regulatory Support Services.

Woman-owned collective of industry experts in DSM program planning and evaluation, with over 60 years of combined experience in the energy efficiency and engineering industry. Members of the Brightline Group has previously worked for GDS on I&M, Ameren Missouri, California POU, and Pennsylvania PUC evaluation and market research projects.

JEFFREY HUBER
Overall Project Manager & MPS Lead
GDS Associates

JACOB THOMAS
Market Research & End-Use Analysis Lead
GDS Associates

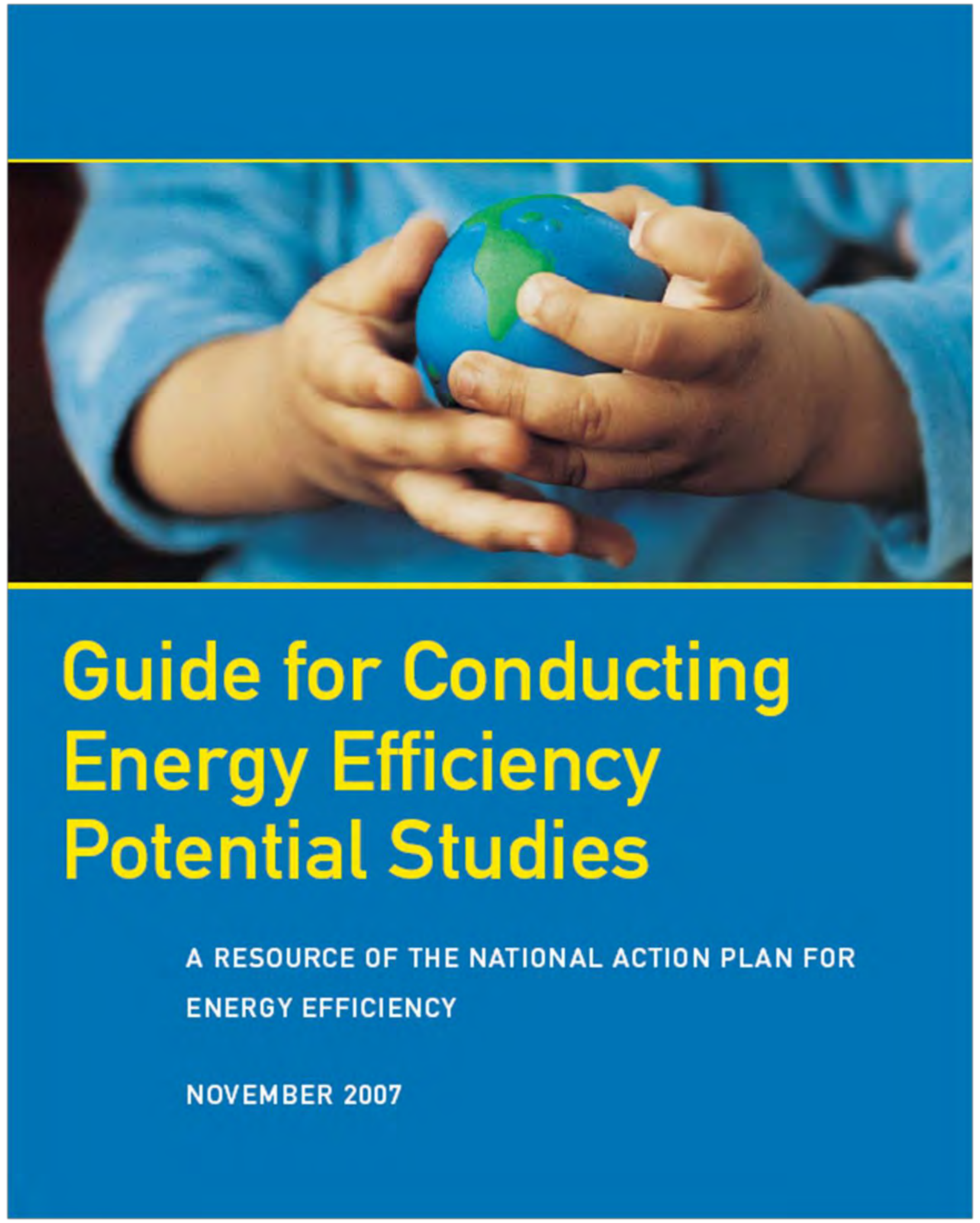
PATRICK BURNS
PV Modeling Lead & Regulatory/IRP Support
Brightline Group

MELISSA YOUNG
Demand Response Lead
GDS Associates

JORDAN JANFLONE
EV Modeling/Forecasting
GDS Associates

What is a Market Potential Study?

Simply put, a potential study is a quantitative analysis of the amount of energy savings that either exists, is cost-effective, or could be realized through the implementation of energy efficiency programs and policies.



Purpose of a Market Potential Study

- **Market Potential Study identifies the remaining amount of EE/DR potential in the AES-IN service territory**
- **The savings potential from this analysis will be used to create EE/DR resources to be modeled in the IRP.**
- **EE/DR selections from the IRP will be used to inform AES-IN DSM plan for 2024-2026.**

DSM Market Potential Study Introduction

Market Research

Jeffrey Huber, Overall Project Manager and MPS Lead, GDS Associates
Jacob Thomas, Market Research and End-Use Analysis Lead, GDS Associates
Melissa Young, Demand Response Lead, GDS Associates

Market Research Activities

RESEARCH TO IMPROVE UPON INPUTS TYPICALLY USED IN BOTH LOAD FORECAST & MPS

- ***Primary & Secondary Research***
  - Surveys & onsite visits
  - Building energy simulation models
  - CBECS
- ***Residential***
  - End Use Market Share
  - Unit Energy Consumption
- ***Small Commercial & Industrial***
  - End-use intensity
  - Distribution of customers by building type
  - End-use saturation

RESEARCH TO HELP UNDERSTAND MOTIVATIONS AND BARRIERS TO ADOPTION

- ***Willingness to Participate (WTP) at varying incentive levels***
  - Residential /Commercial
  - Asked for EE / DR / DER
- ***Importance of financial/non-financial motivations and barriers toward adoption***
  - Motivations: *Energy/bill savings, personal sustainability goals, improved comfort, increased reliability, quieter operation, etc.*
  - Barriers: *Upfront cost, access to financing, uncertainty about savings, lack of knowledge, limitations of building characteristics, unwanted features or negative impacts on aesthetics/comfort, etc.*
- ***Awareness of current AES-IN Programs***

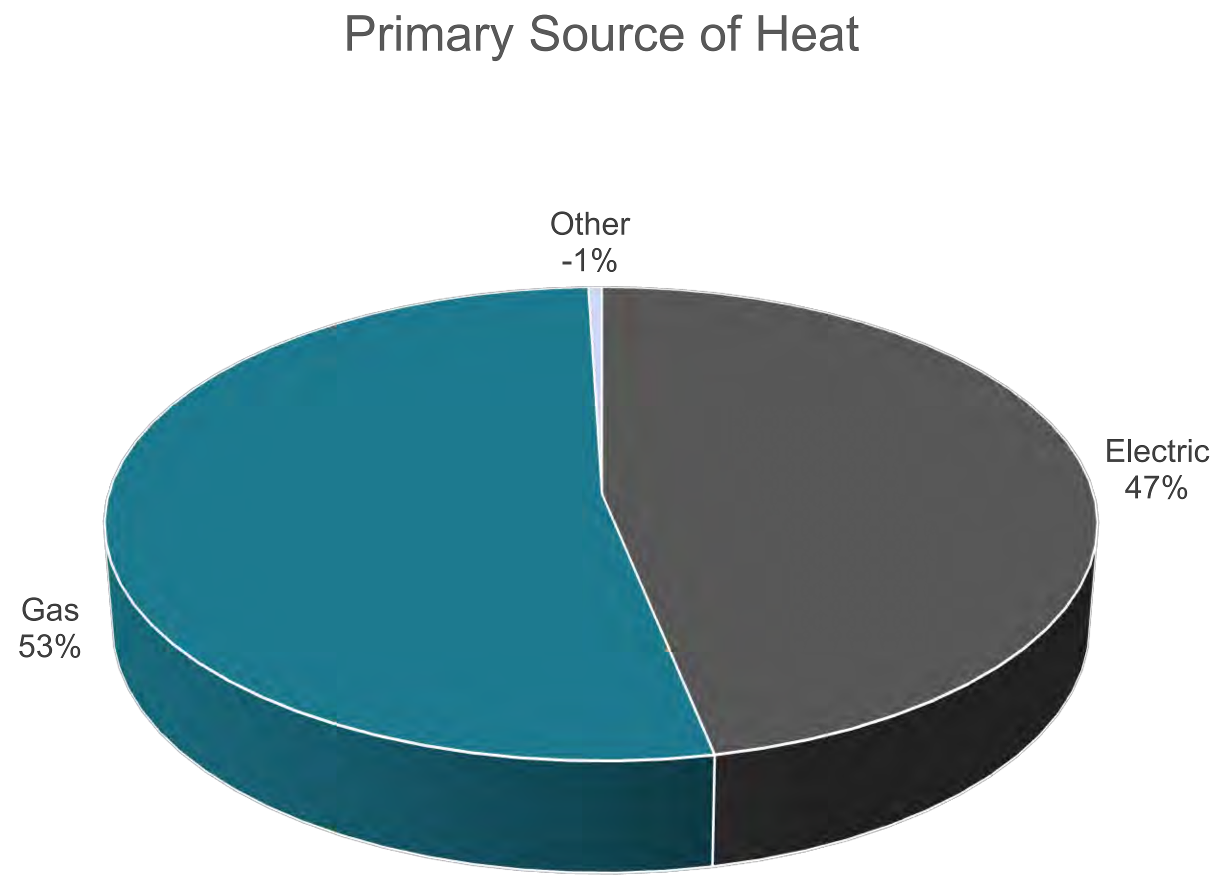
Residential Baseline Survey Statistics

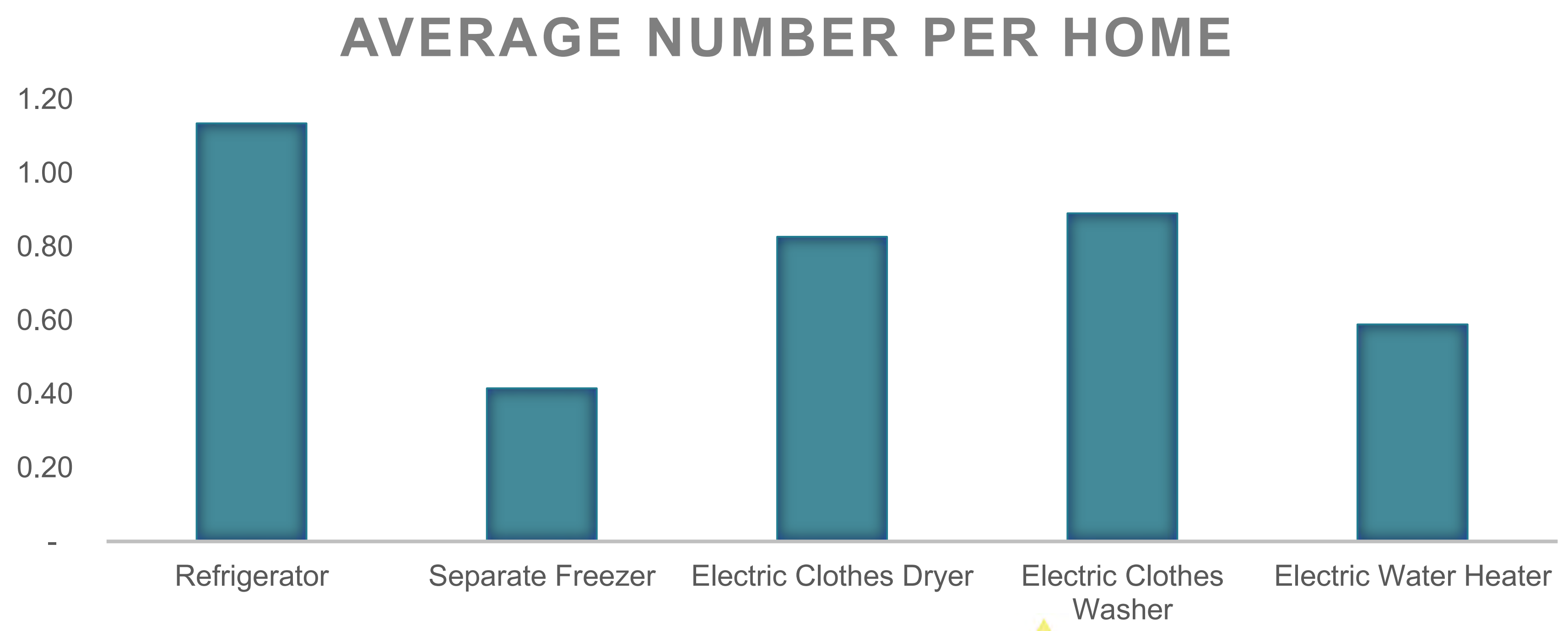
Market Segment	Sample Design	Sample Frame	# of Responses	Response Rate	Achieved Precision
Total Residential Population	95/5 Design = 384 Responses	15,000 (100%)	972	6.5%	3.1% @ 95% Conf.
Multifamily Homes	90/10 Design = 68 Responses	2,720 (18%)	231	8.5%	5.4% @ 90% Conf.
Single Family Homes	316 Responses	12,280 (82%)	741	6.0%	3.0% @ 90% Conf.

* *Commercial survey underway. Roughly 9,000 accounts in sample frame.*

Equipment Characteristics

- *Data collection elements limited to items that may be answered accurately*
- Residential survey collected
  - Ownership, age, and count of electric end-use appliances
  - Information on smart appliances and electric vehicles
- Nonresidential survey focused on key electric end-uses
  - Ex: Lighting, Cooling, Heating, Ventilation, Water Heating, Refrigeration
  - Key Equipment Penetration
  - Limited Efficiency Saturation Characteristics





Willingness to Participate (WTP) Sample Sizes

Residential Modules	Est # of Completions	Actual # of Completions	Achieved Precision @ 90% Confidence
Water Heater Efficiency	180	349	4.4%
Clothes Dryer Efficiency	146	264	5.1%
Insulation Efficiency	230	279	4.9%
HVAC Efficiency	195	283	4.9%
DER – Solar PV	180	269	5.0%
DER – Electric Vehicles	195	236	5.4%
Water Heater Control DR	146	229	5.4%
Smart Thermostat DR	158	157	6.6%
Time of Use Rate DR	72	88	8.8%

** Commercial WTP survey underway. Similarly targets several commercial EE end-uses (HVAC, Water Heating, Refrigeration, Lighting), DER (Solar Purchase/Leased) and DR (AC Control, Critical Peak Pricing) options.*

WTP Survey Research

- → Represents the proportion of customers who can be reasonably expected to perform energy efficiency upgrades through DSM programs
- → Used to estimate likely long-term adoption rates for achievable potential scenarios

→Long-term adoption rates will be estimated at the end-use or measures level for key end uses:

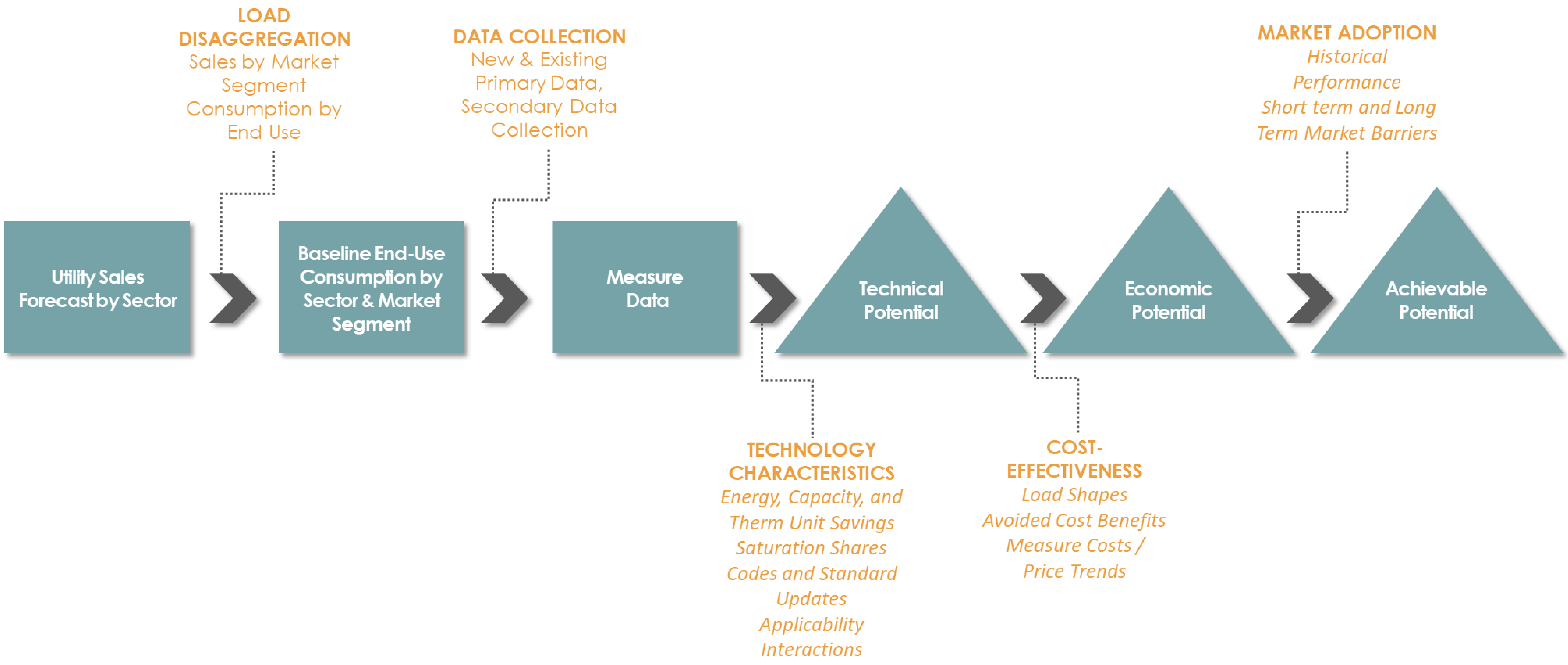
- HVAC
- Water Heating
- Lighting
- Refrigeration
- Appliances
- Building Shell
- Distributed Energy Resources
- Demand Response

DSM Market Potential Study Introduction

Energy Efficiency (EE) Potential

Jeffrey Huber, Overall Project Manager and MPS Lead, GDS Associates
Jacob Thomas, Market Research and End-Use Analysis Lead, GDS Associates
Melissa Young, Demand Response Lead, GDS Associates

Overall Market Potential Study Process



MPS Segmentation

Residential		Commercial		Industrial	
Home Types	**End-Uses**	**Building Types**	**End-Uses**	**Industry Types**	**End-Uses**
Single Family – Market Rate	Whole Building	Education	Whole Building	Chemicals	HVAC
Multifamily – Market Rate	Heat	Food/Liquor	Heat	Electronics	Lighting
Single Family – Income Qualified	Cool	Health Care	Cool	Fabricated Metals	Machine Drive
Multifamily – Income Qualified	WH	Hotel	Vent.	Food	Process Heat
	Int. Lighting	Miscellaneous	Refrigeration	Lumber & Furniture	Process Refrigeration
	Ext. Lighting	Office	WH	Average	Other Process
	Refrigeration	Restaurant	Cook	Nonmetallic Mineral	Other Facility
	Other Appliances	Retail Store	Interior Lighting	Paper	
	Electronics	Warehouse	Exterior Lighting	Chemicals	
	Pools		Office Equip.	Plastics	
	Misc.		Misc.	Primary Metals	
			Air Comp.	Transportation	
			Motors		
			Proc.		

Measure Characterization

- ❑ Several hundred energy efficiency measures will be considered
- ❑ Draft list of measures to be considered were shared with AES-IN Staff and members of the AES-IN Oversight Board (OSB)
- ❑ Key data source: AES-IN planning and evaluation databases and Illinois TRM
- ❑ Measure assumptions include:
  - o Savings
  - o Incremental/full costs
  - o Measure interaction
  - o Measure life
  - o Measure Applicability

GDS Associates, Inc. ENGINEERS & CONSULTANTS
brightline GROUP
aes Indiana

Emerging Technologies

→ Emerging technologies and practices are defined as those that are either: (1) not yet commercialized but are likely to be commercialized and cost-effective for a significant proportion of end-users (on a life-cycle cost basis) over the next few years; or (2) commercialized, but currently have penetrated no more than 2% of the appropriate market (ACEEE)

  → Reviewed latest TRMs, DOE databases, and the Northwest Energy Efficiency Alliance Emerging Tech Advisory Committee.

→ Require some documented estimate of savings and/or costs for inclusion.

→ **MPS does not include a placeholder for "future unknown technologies"**

GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

Energy Efficiency Potential Types

TECHNICAL POTENTIAL

All technically feasible measures are incorporated to provide a theoretical maximum potential.

ECONOMIC POTENTIAL

All measures are screened for cost-effectiveness using the UCT Test. Only cost-effective measures are included.

ACHIEVABLE POTENTIAL

Cost-effective energy efficiency potential that can practically be attained in a real-world program delivery case, assuming that a certain level of market penetration can be attained.

Types of Energy Efficiency Potential

Not Technically Feasible	TECHNICAL POTENTIAL		
Not Technically Feasible	Not Cost-Effective	ECONOMIC POTENTIAL	
Not Technically Feasible	Not Cost-Effective	Market & Adoption Barriers	ACHIEVABLE POTENTIAL

Technical Potential Calculation

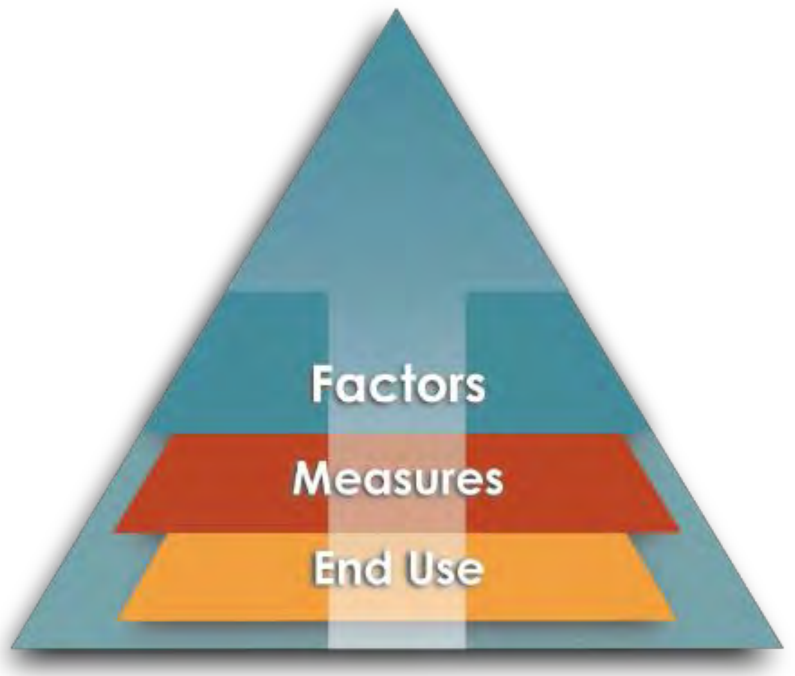
RESIDENTIAL EQUATION

TECHNICAL POTENTIAL OF EFFICIENT MEASURES = *Total Number of Households* X *Base Case Equipment End Use Intensity* X *Saturation Share* X *Applicability Factor* X *Savings Factor*

NON-RESIDENTIAL EQUATION

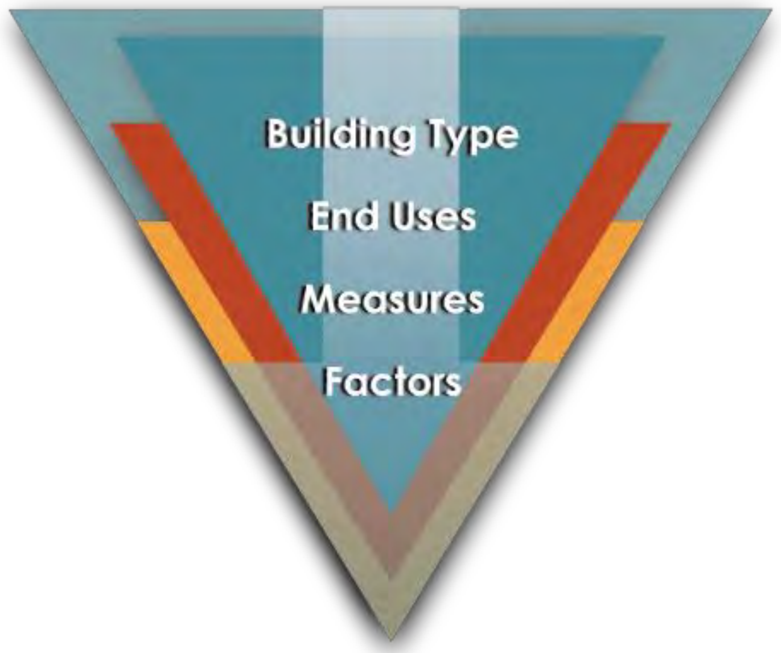
TECHNICAL POTENTIAL OF EFFICIENT MEASURES = *Total End Use Sales By Industry Type* X *Base Case Factor* X *Remaining Factor* X *Convertible Factor* X *Savings Factor*

"BOTTOM-UP APPROACH"
Residential Energy Savings



# of Residential Homes

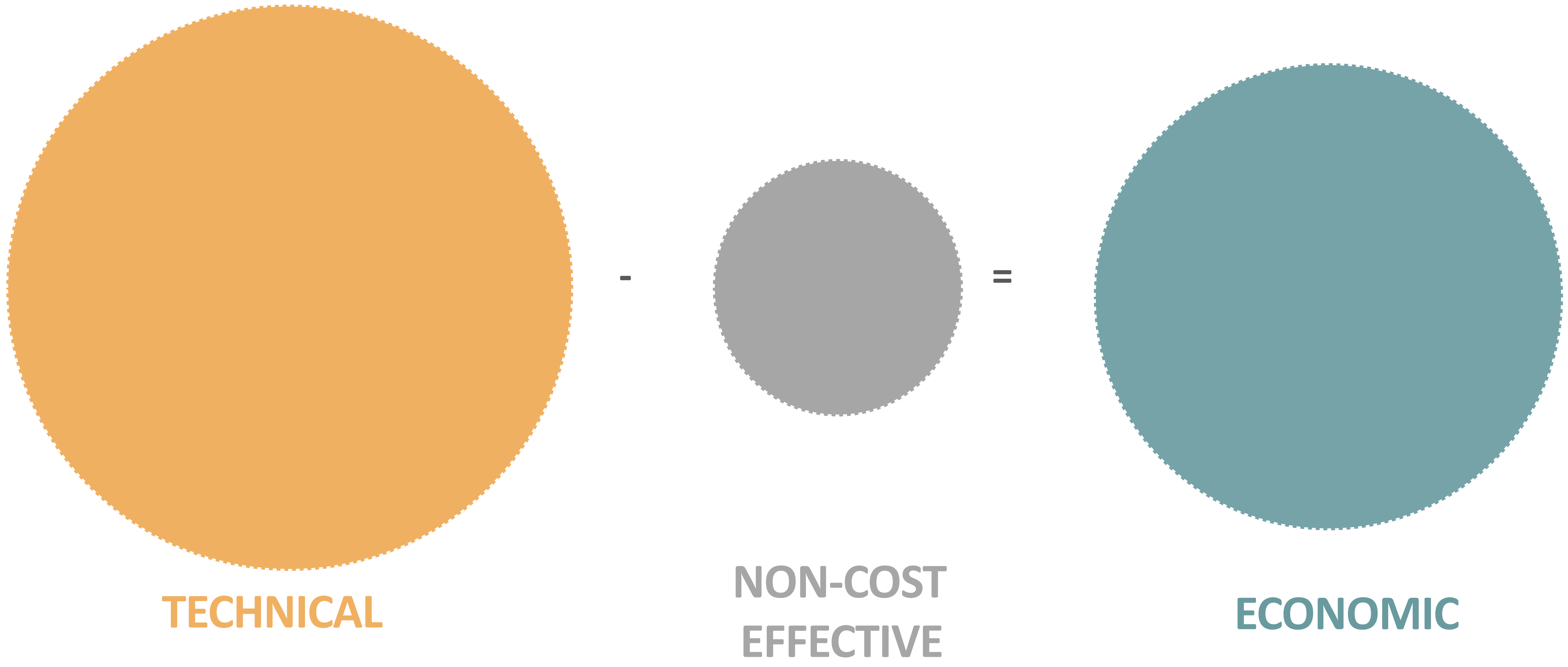
"TOP-DOWN APPROACH"
Commercial Energy Sales



Commercial Energy Savings

GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

Economic Potential

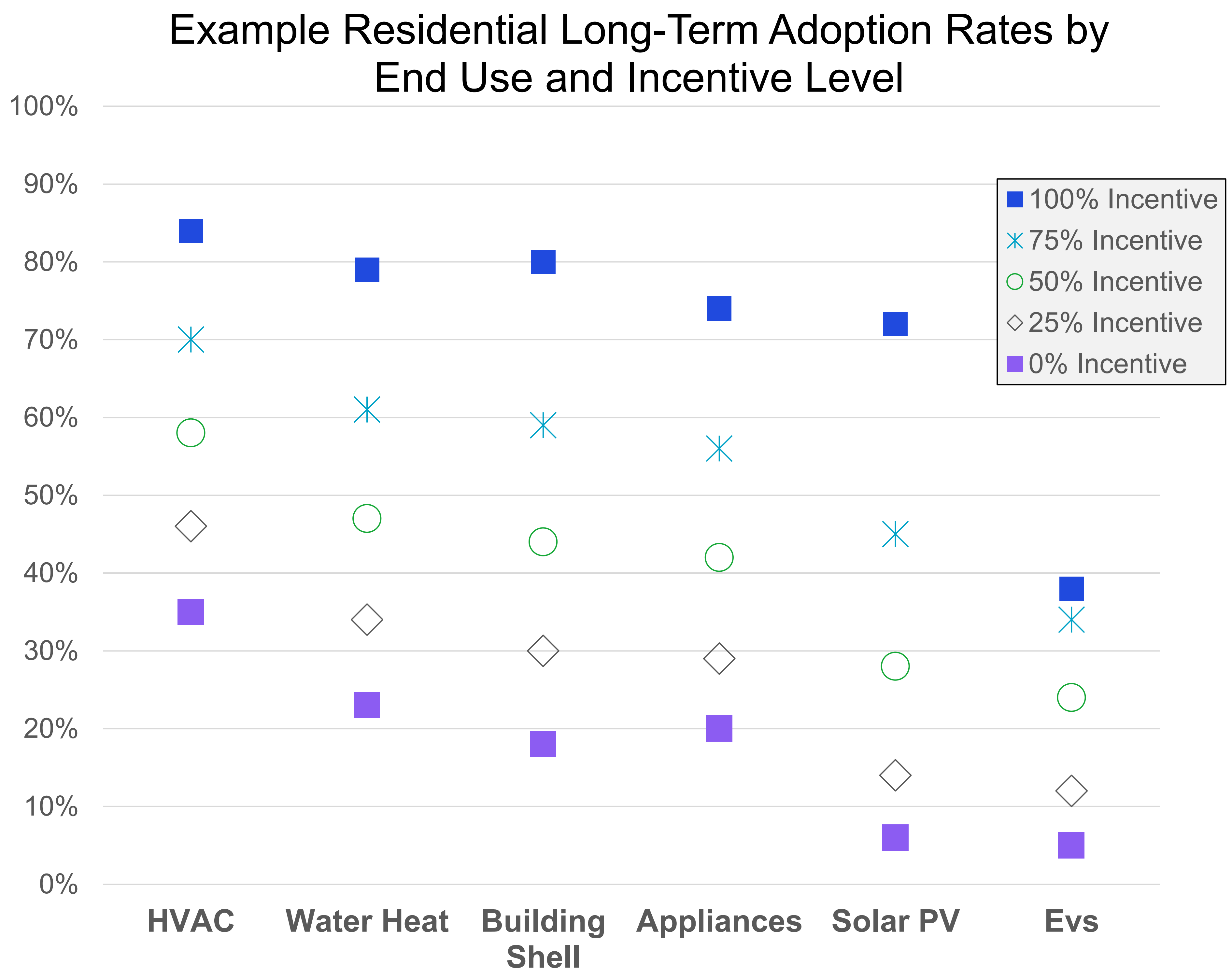


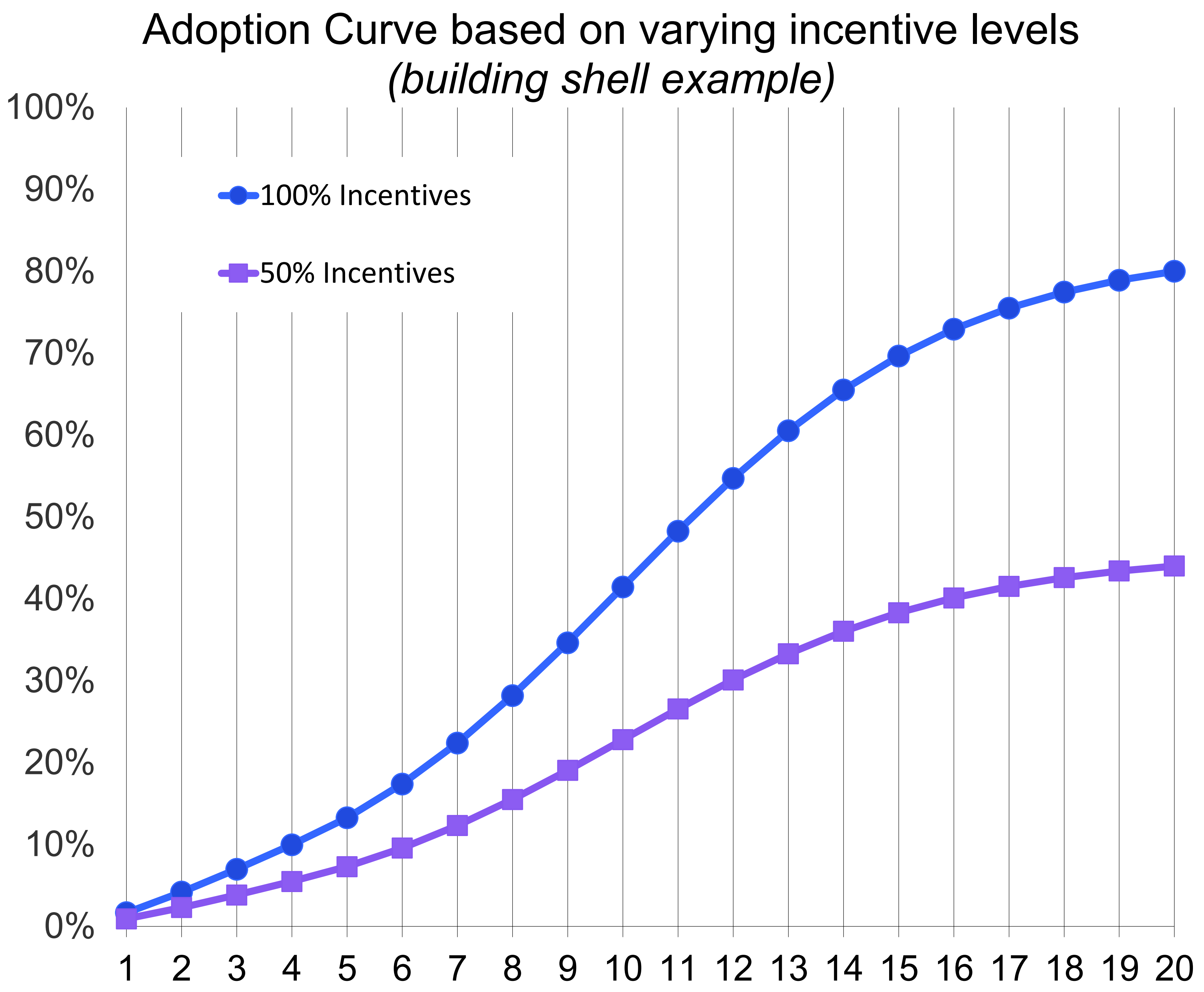
ECONOMIC POTENTIAL

Subset of the Technical Potential that is economically cost effective (based on screening with the Utility Cost Test)

Screen measures for cost-effectiveness over the 20-year forecast horizon

Achievable / Program Potential





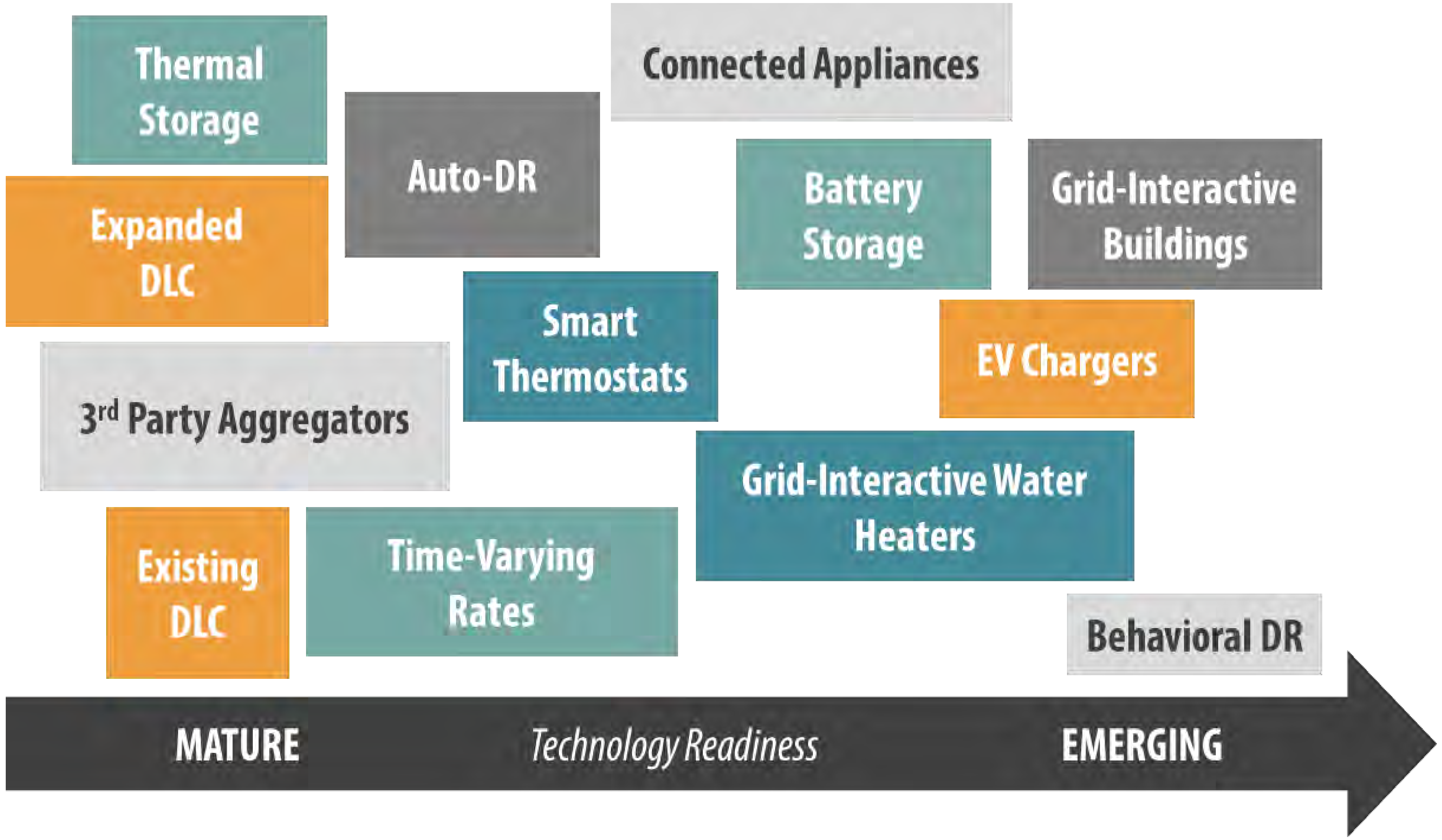
DSM Market Potential Study Introduction

Demand Response (DR) Potential

Jeffrey Huber, Overall Project Manager and MPS Lead, GDS Associates
Jacob Thomas, Market Research and End-Use Analysis Lead, GDS Associates
Melissa Young, Demand Response Lead, GDS Associates

Demand Response Programs Considered

- → DLC – Central ACs
- → DLC –Room ACs
- → DLC – Smart Appliances
- → DLC – Water Heaters
- → DLC – Electric Space Heat
- → DLC – Lighting
- → Battery Energy Storage
- → Electric Vehicle Charing
- → Curtailment Agreements
- → Demand Bidding
- → Capacity Bidding
- → Time of Use Rates
- → Behavior DR



GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

Demand Response Methodology

→ Analysis will be conducted using GDS Demand Response Model (DR Model)

→ Utility-specific data on avoided costs, line losses, and discount rates will be incorporated

→ Participation rates will be developed to simulate the rate at which load reductions can be attained over time

→ Current data on the estimated coincident peak (CP) load reduction per participant will be used to calculate the achievable potential

GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

Demand Response Equations

Achievable Potential Calculation:

- If the model user chooses to base estimated potential demand reduction on percent of total per participant CP load, then:

Achievable Demand Response Potential = **Potentially Eligible Customers** X **Eligible Customer Participation Rate** X **Per Customer CP Load for Eligible Customer Segment (kW)** X **Percent CP Load Reduction per Participant**

- If the model user chooses to base estimated potential demand reduction on a per customer CP load reduction value, then:

Achievable Demand Response Potential = **Potentially Eligible Customers** X **Eligible Customer Participation Rate** X **Per Customer CP Load Reduction for Eligible Customer Segment (kW)**

Final Q&A and Next Steps

AES Indiana

Thank You

APPENDIX

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
- BESS: Battery Energy Storage System
- BNEF: Bloomberg New Energy Finance
- BTA: Build-Transfer Agreement
- C&I: Commercial and Industrial
- CAA: Clean Air Act
- CAGR: Compound Annual Growth Rate
- CCGT: Combined Cycle Gas Turbines
- CCS: Carbon Dioxide Capture and Storage
- CDD: Cooling Degree Day
- COD: Commercial Operation Date
- CONE: Cost of New Entry
- CP: Coincident Peak
- CPCN: Certificate of Public Convenience and Necessity
- CT: Combustion Turbine
- CVR: Conservation Voltage Reduction
- DER: Distributed Energy Resource
- DG: Distributed Generation
- DGPV: Distributed Generation Photovoltaic System
- DLC: Direct Load Control
- DOE: U.S. Department of Energy
- DR: Demand Response
- DRR: Demand Response Resource
- DSM: Demand-Side Management
- 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
- EV: Electric Vehicle
- GDP: Gross Domestic Product
- GT: Gas Turbine
- HDD: Heating Degree Day
- HVAC: Heating, Ventilation, and Air Conditioning
- IAC: Indiana Administrative Code
- IC: Indiana Code
- ICAP: Installed Capacity
- ICE: Internal Combustion Engine
- IRP: Integrated Resource Plan
- ITC: Investment Tax Credit
- IURC: Indiana Regulatory Commission
- kW: Kilowatt
- kWh: Kilowatt-Hour
- LED: Light Emitting Diode
- LMR: Load Modifying Resource
- LNBL: Lawrence Berkeley National Laboratory
- Max Gen: Maximum Generation Emergency Warning
- MIP: Mixed Integer Programming
- MISO: Midcontinent Independent System Operator
- MPS: Market Potential Study
- MW: Megawatt
- NDA: Nondisclosure Agreement
- NOX: Nitrogen Oxides
- NREL: National Renewable Energy Laboratory
- PPA: Power Purchase Agreement
- PRA: Planning Resource Auction
- 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
- REC: Renewable Energy Credit
- REP: Renewable Energy Production
- RFP: Request for Proposals
- RIIA: MISO's Renewable Integration Impact Assessment
- SAC: MISO's Seasonal Accredited Capacity
- SCR: Selective Catalytic Reduction System
- SMR: Small Modular Reactors
- ST: Steam Turbine
- SUFG: State Utility Forecasting Group
- TRM: Technical Resource Manual
- UCT: Utility Cost Test
- UCAP: Unforced Capacity
- 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 #2

4/12/2022

aes Indiana

Agenda and Introductions

Stewart Ramsay, Managing Executive, Vanry & Associates

Agenda

Time	Topic	Speakers
Morning Starting at 10:00 AM	Virtual Meeting Protocols and Safety, Schedule	Chad Rogers, Senior Manager, Regulatory Affairs, AES Indiana
	Meeting #1 Recap	Erik Miller, Manager, Resource Planning, AES Indiana
	Load Scenarios	Mike Russo, Forecast Consultant, Itron Eric Fox, Director, Forecasting Solutions, Itron
	MPS Results & DSM Resources	Jeffrey Huber, Overall Project Manager and MPS Lead, GDS Associates
Break 12:00 PM – 12:30 PM	Lunch	
Afternoon Starting at 12:30 PM	Current Generation Portfolio Overview	Kristina Lund, President & CEO, AES Indiana
	Replacement Resource Assumptions	Erik Miller, Manager, Resource Planning, AES Indiana
	IRP Portfolio Matrix & Scenario Framework	Erik Miller, Manager, Resource Planning, AES Indiana
	Final Q&A and Next Steps	

**Distribution System Planning was included on a prior distributed agenda. This topic will be covered in Public Advisory Meeting #3.*

aes Indiana

Virtual Meeting Protocols and Safety

Chad Rogers, Senior Manager, Regulatory Affairs, AES Indiana

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 Public Relations Officer, AES Indiana
Ahmed Pasha, Chief Financial Officer, AES Indiana
Tom Raga, Vice President Government Affairs, AES Indiana
Judi Sobecki, General Counsel and Chief Regulatory Officer, 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, Senior Manager, Regulatory Affairs, AES Indiana
Brent Selvidge, Engineer, AES Indiana
Will Vance, Senior Analyst, AES Indiana

AES Indiana IRP Partners

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
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

AES Indiana Legal Team

Nick Grimmer, Indiana Regulatory Counsel, AES Indiana
Teresa Morton Nyhart, Counsel, Barnes & Thornburg LLP

Welcome to Today's Participants

ACES
Advanced Energy Economy
Barnes & Thornburg LLP
Boardwalk Pipelines
Butler University
CCR
CenterPoint Energy
Citizens Action Coalition
City of Indianapolis
Clean Grid Alliance
Develop Indy | Indy Chamber
Duke Energy
E&C
EDP Renewables NA
Energy Futures Group
Faith in Place
Fluence Energy
GDS Associates
Hallador Energy

Hoosier Energy
IBEW LOCAL UNION 1395
Indiana Chamber
Indiana Energy Association
Indiana Utility Regulatory Commission
IUPUI
NuScale Power
Office of Utility Consumer Counselor
Purdue - State Utility Forecasting Group
Rolls-Royce/ISS
Sierra Club
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

Make your virtual environment safer

1.

Secure Your Accounts Use unique, complex passphrases and enable two-factor authentication wherever possible.

2.

Think before you click on a link, file, or attachment on your laptop and mobile.

3.

Know Your Network Protect your home network by changing default passwords; use a VPN when conducting sensitive transactions or on public WiFi.

4.

Protect your Device Patch your devices regularly and be mindful of connecting unauthorized hardware like USB drives.

5.

Share Data Responsibly Control your social media settings and be mindful when posting publicly.

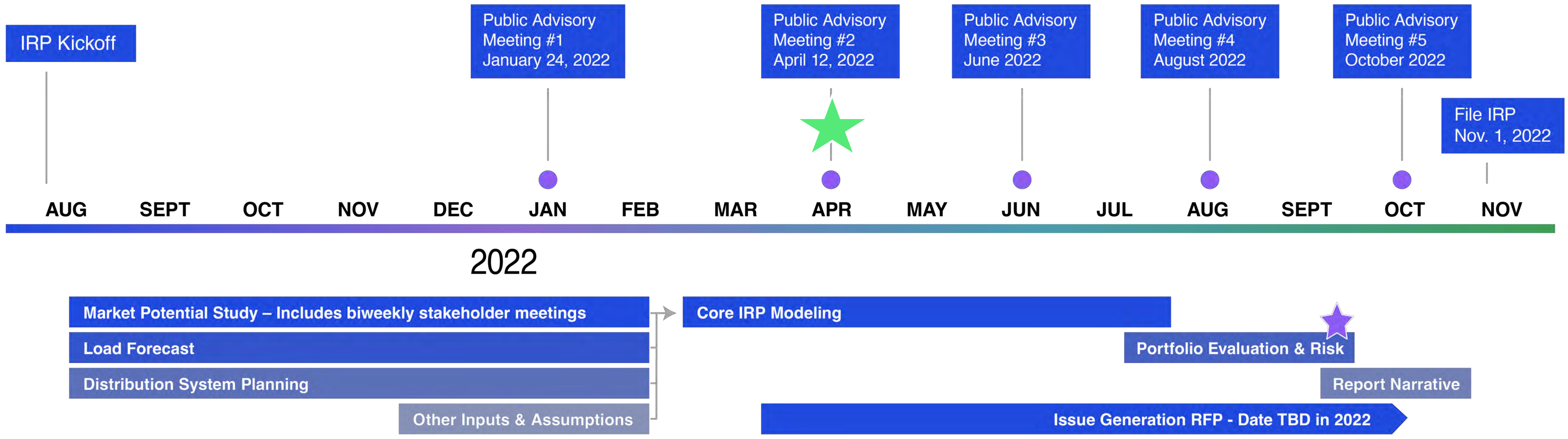
6.

Be Safe by Being Prepared Know the cyberattack types and report anything suspicious.

Meeting #1 Recap

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.

aes Indiana

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

- Portfolio Metrics & Scorecard Framework
- Overview of Reliability in Indiana
- Reliability Analysis
- Distribution System Plan

Public Advisory Meeting #4 - August

- Preliminary Modeling Results
- Risk Analysis
- Portfolio Metrics & Scorecard Review

Public Advisory Meeting #5 - October

- 2022 Modeling Insights
- Preferred Resource Portfolio & Short-Term Action Plan

Topics for meetings 3-5 are subject to change depending on modeling progress.

2022 Integrated Resource Plan (IRP)

Load Scenarios

Presented by Itron

Itron aes Indiana

Load Scenarios

High/Low Load Model Drivers

Mike Russo, Forecast Consultant, Itron

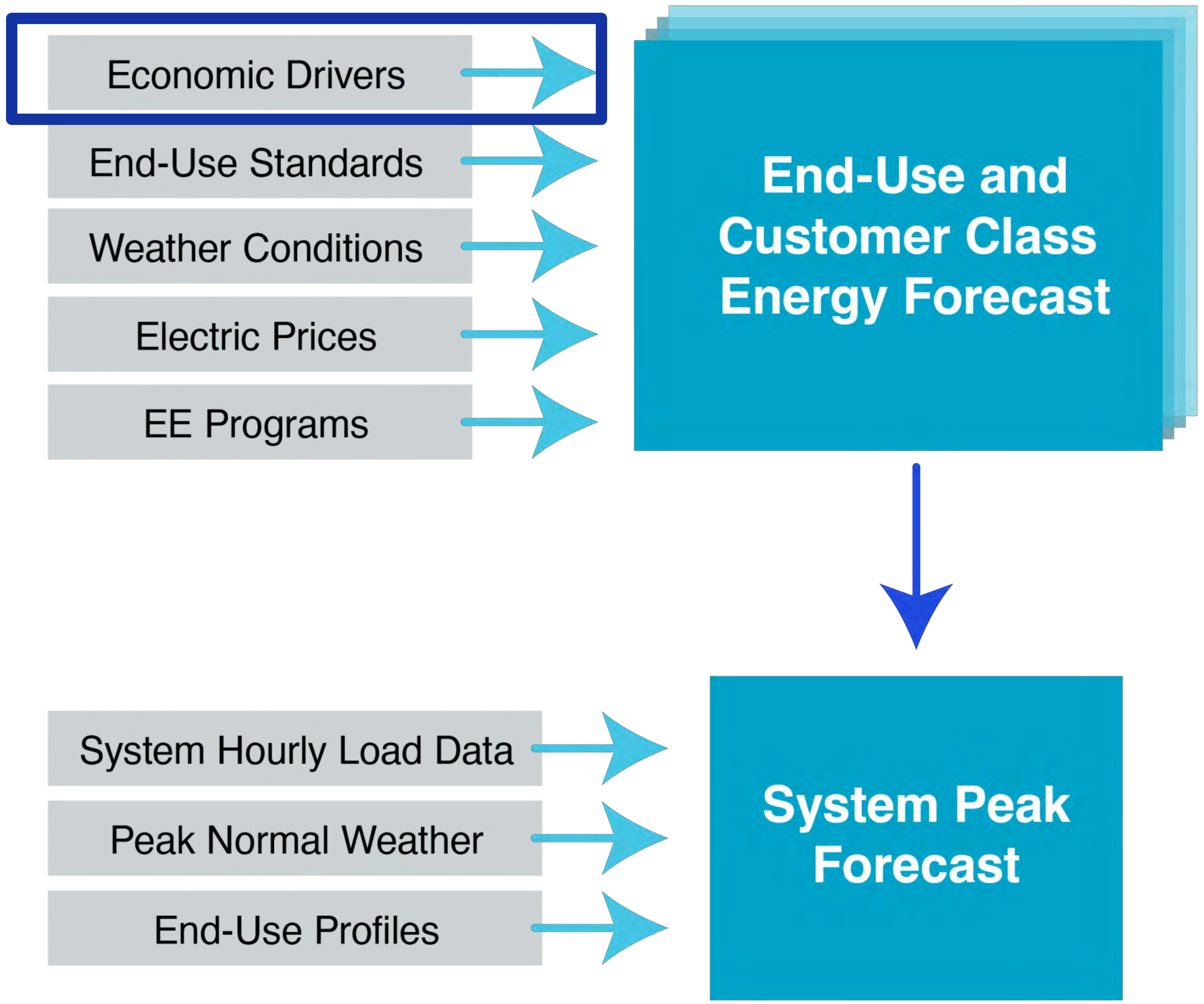
Modeling Approach

- Bottom-up Modeling Approach
- Estimate rate-class level sales and customer models from historical billed sales data
- Sales/energy driven by households, economic forecasts, expected weather conditions, price, and end-use efficiency improvements. End-use demand drives system peak demand

Monthly sales and customer models are estimated for:

- Residential
- Commercial
- Industrial
- Other (Lighting)

Monthly peak model driven by end-use energy forecasts



The baseline forecast excludes behind the meter solar, electric vehicle loads, and future EE program savings

Economic Based Scenarios

Baseline Forecast

→ Baseline forecast models use economic concepts from Moody's Analytics Baseline Forecast, Aug 2021. Moody's defines their baseline forecast as "the probability that the economy will perform better than this projection is equal to 50%, the same as the probability that it will perform worse".

Low Forecast Scenario

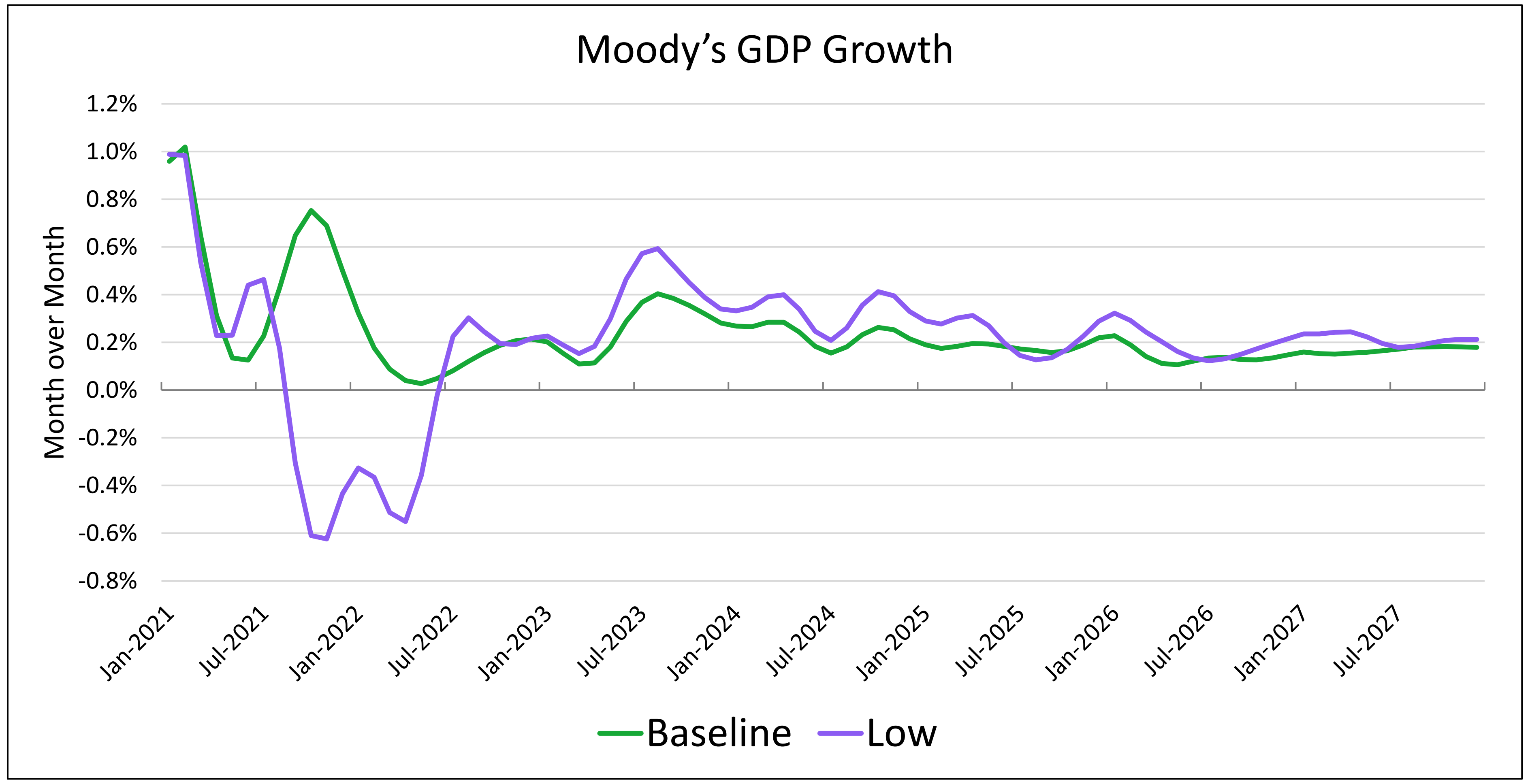
→ Based on Moody's S3: Alternative Scenario 3 – Downside – 90th Percentile: In this scenario, there is a 90% probability that the economy will perform better, broadly speaking, and a 10% probability that it will perform worse.

High Forecast

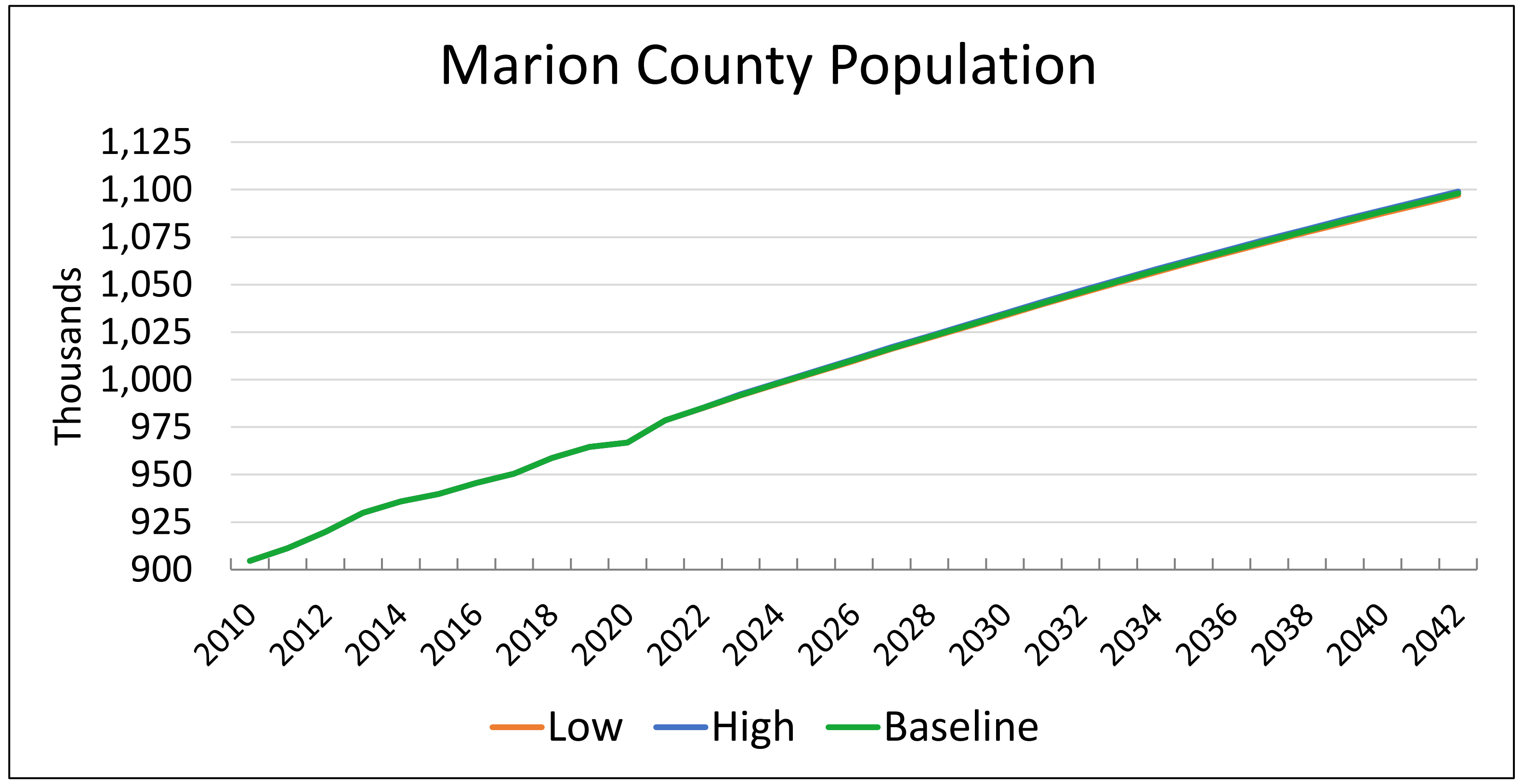
→ Based on Moody's S1: Alternative Scenario 1 – Upside – 10th Percentile: In this scenario, there is a 10% probability that the economy will perform better, broadly speaking, and a 90% probability that it will perform worse.

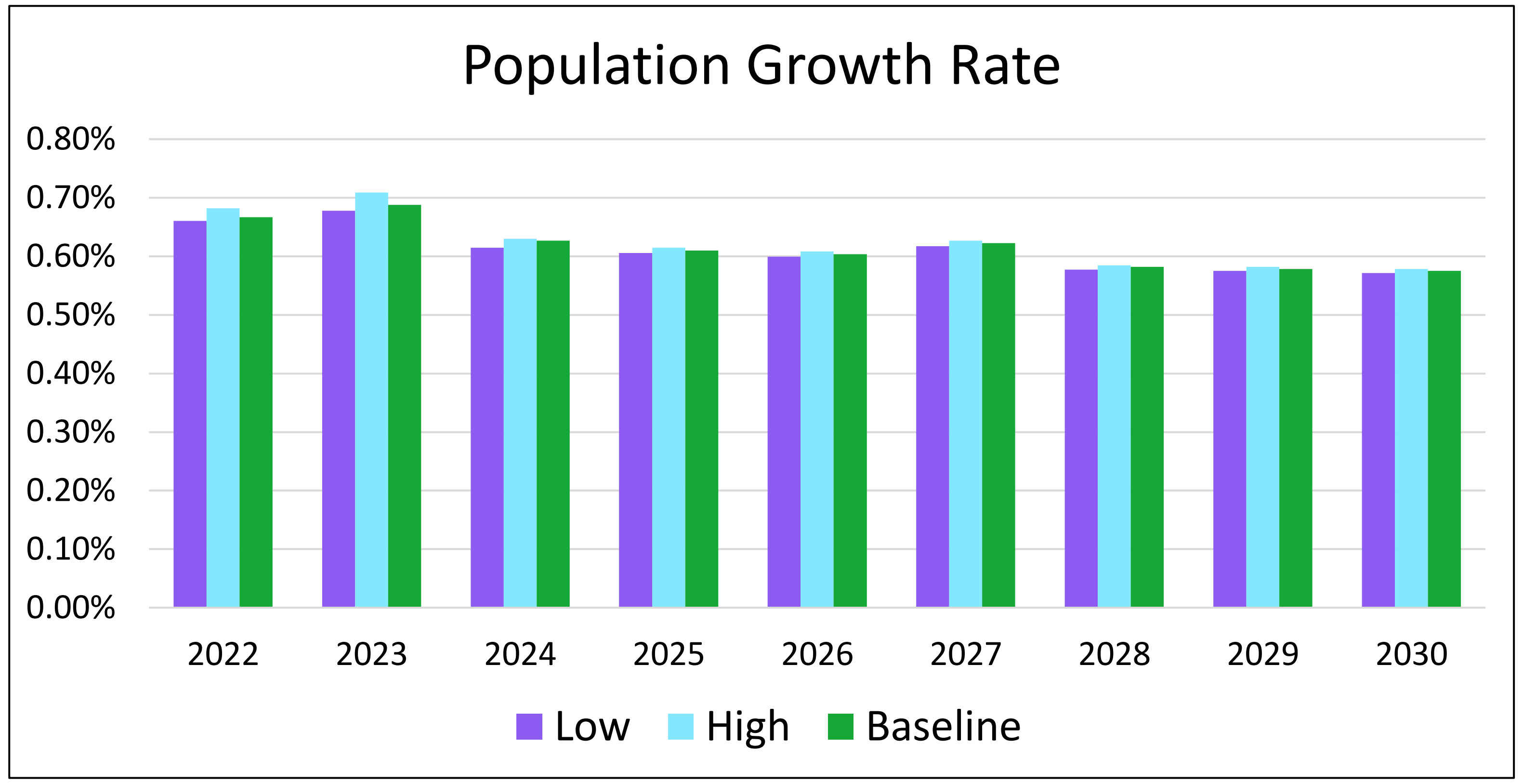
Construction of Scenario Economic Drivers

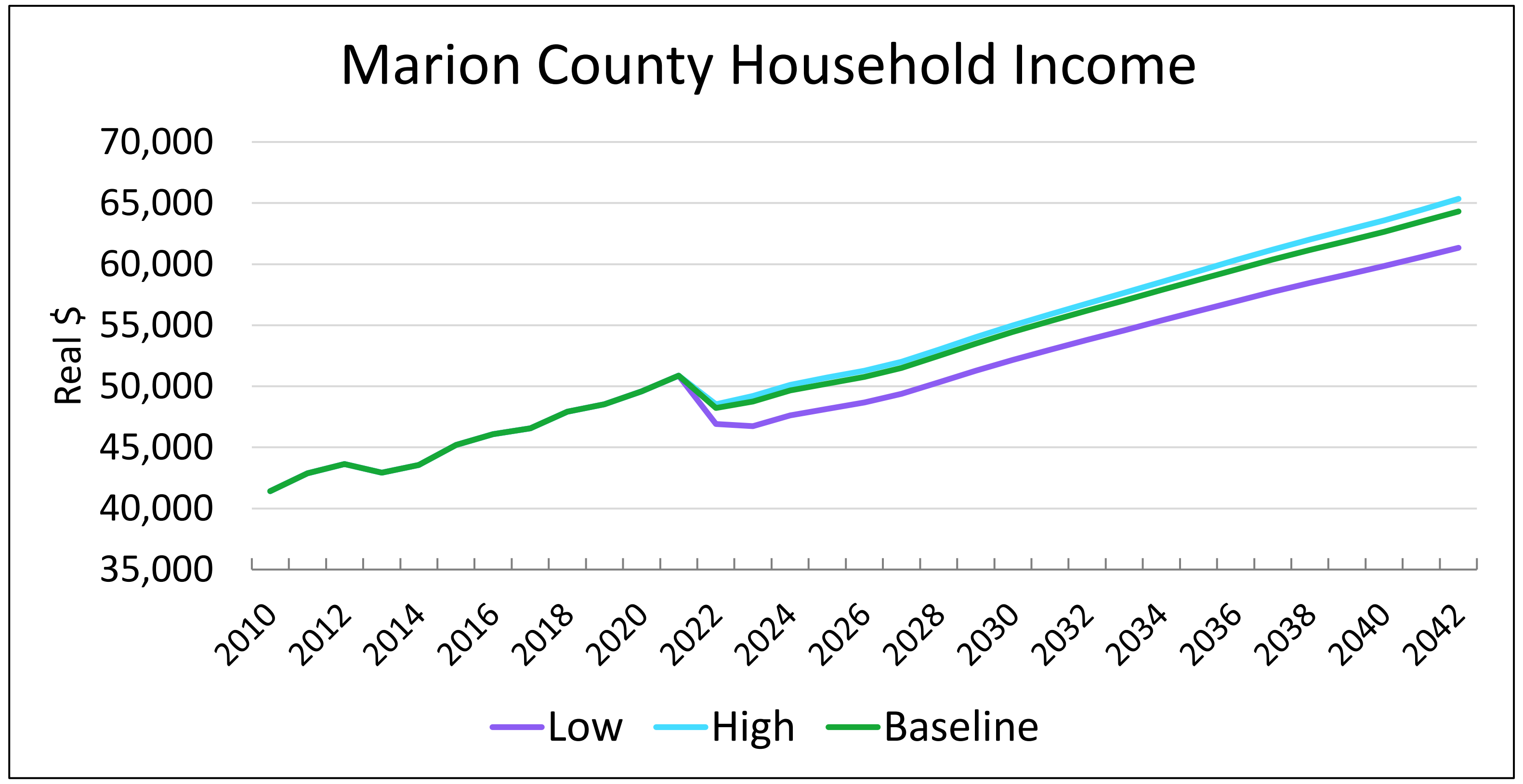
- Growth rates from the Moody's Low/High scenarios are applied to the Baseline economic variables beginning in January 2022
- The chosen methodology ensures the growth rates used are less than or equal to the Baseline growth rates in the Low case and greater than or equal to the Baseline growth rates in the High case.
  - If this adjustment were not made Low case growth rates would be greater than the baseline in certain years, as seen below. This could result in the Low load forecast exceeding the Baseline load forecast.

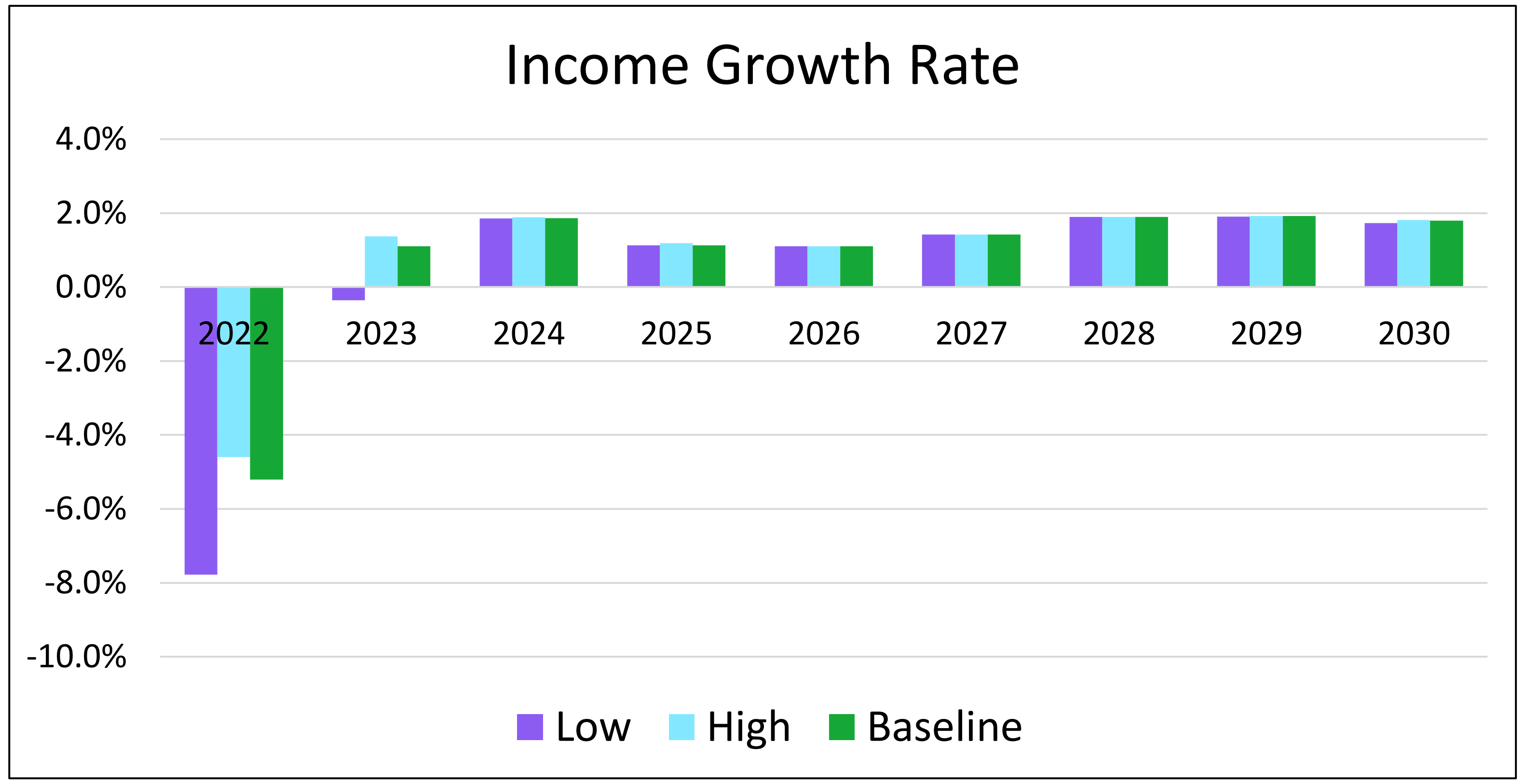


Residential Economic Drivers



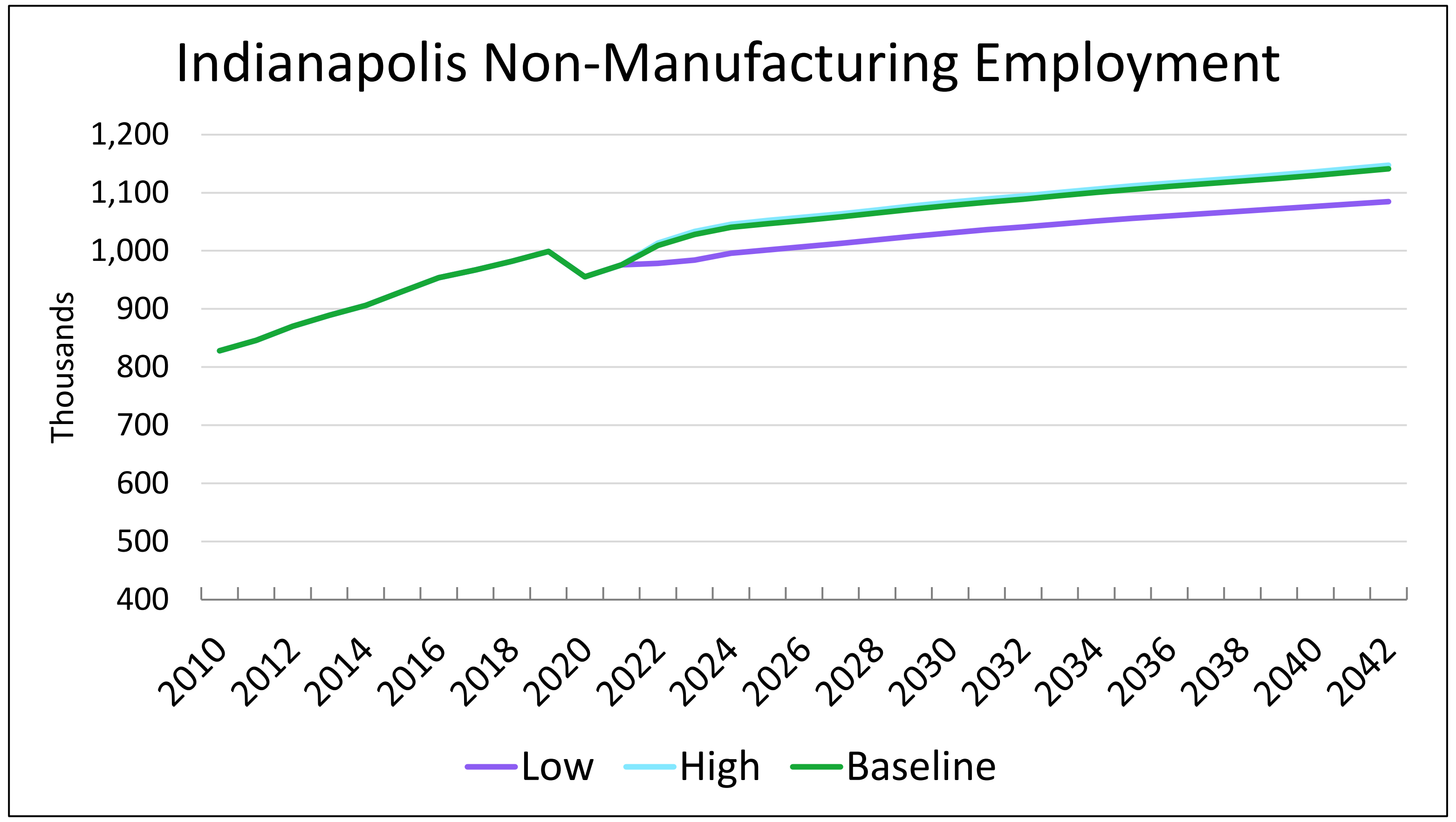


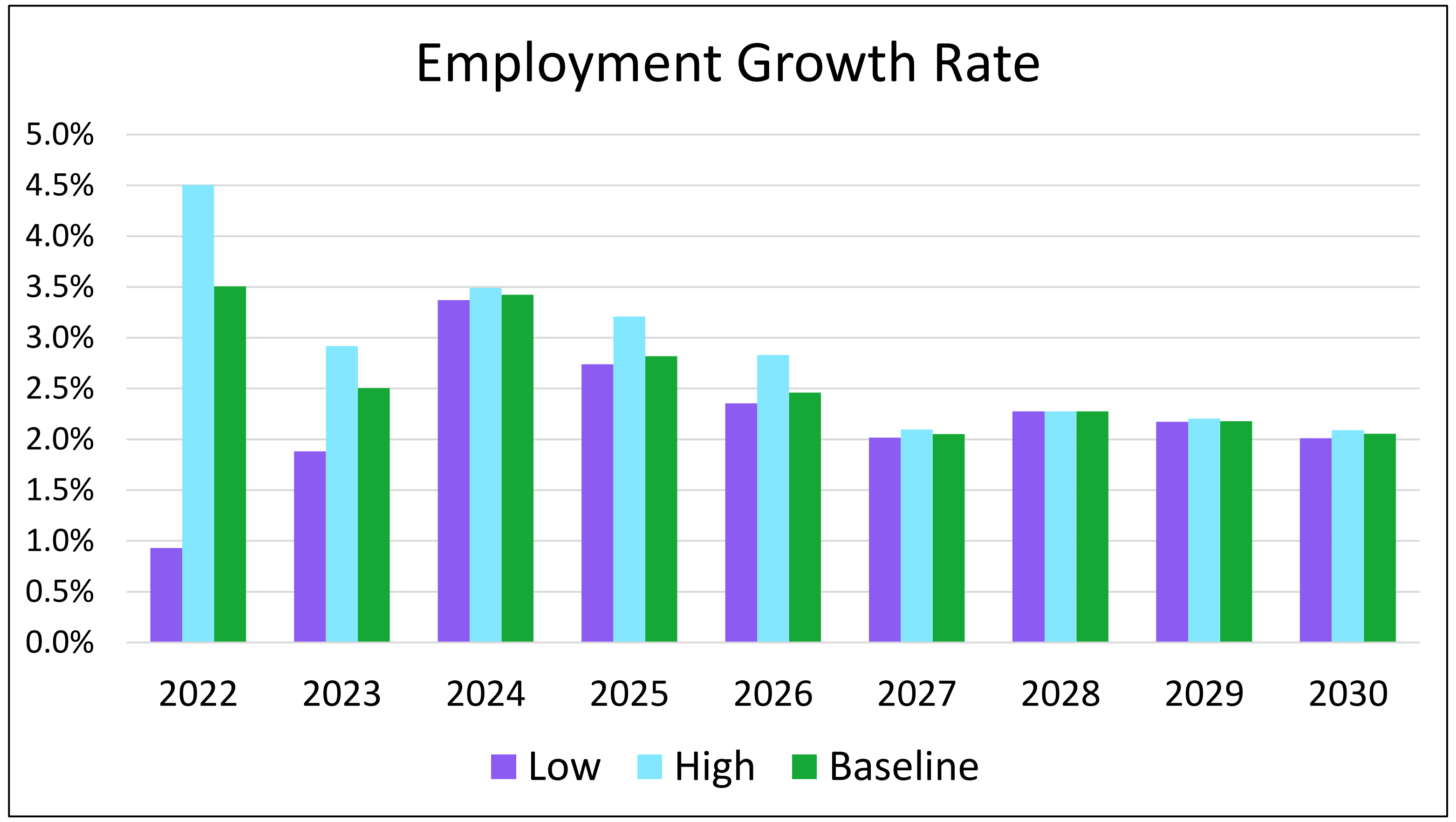


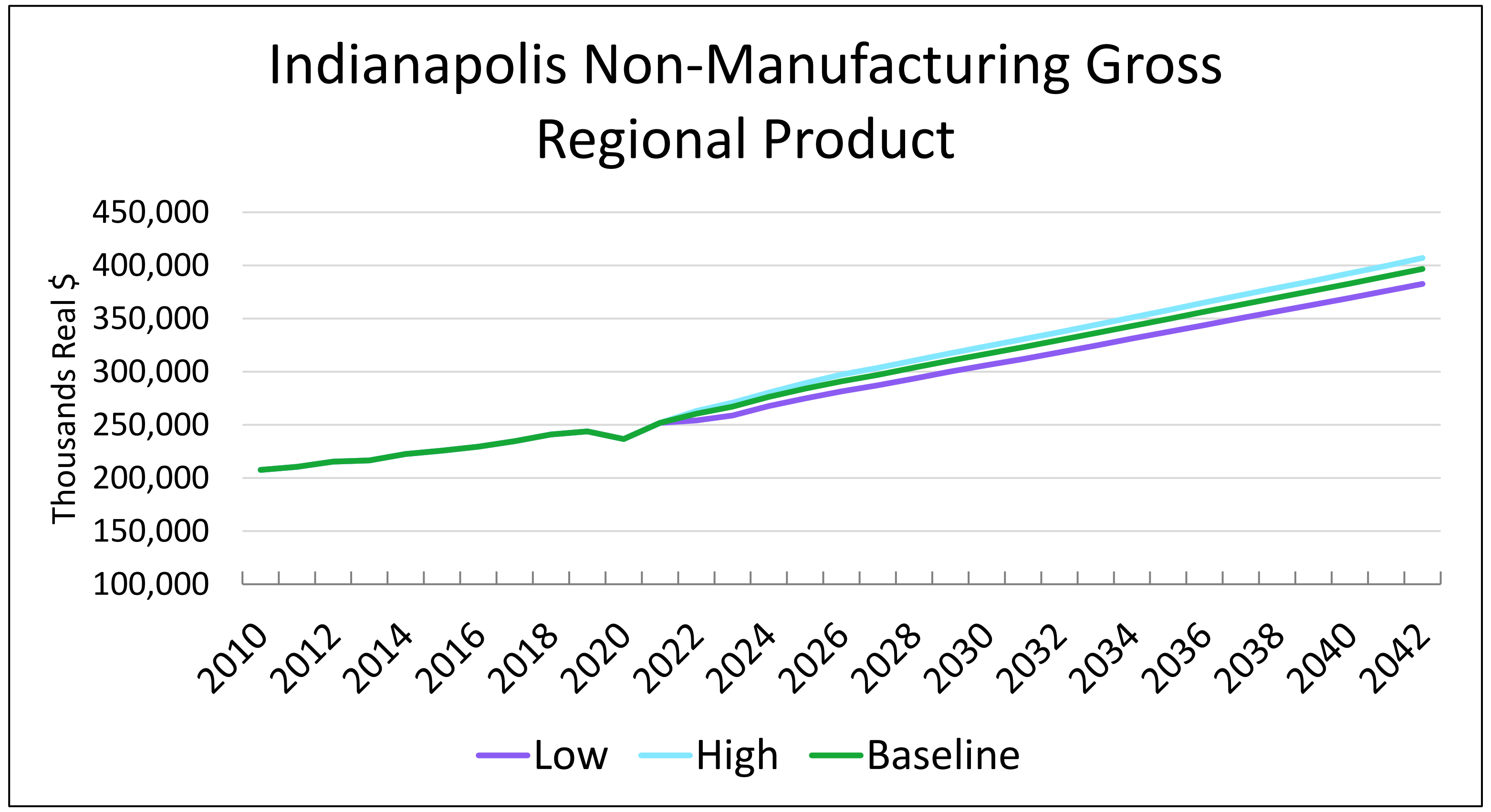


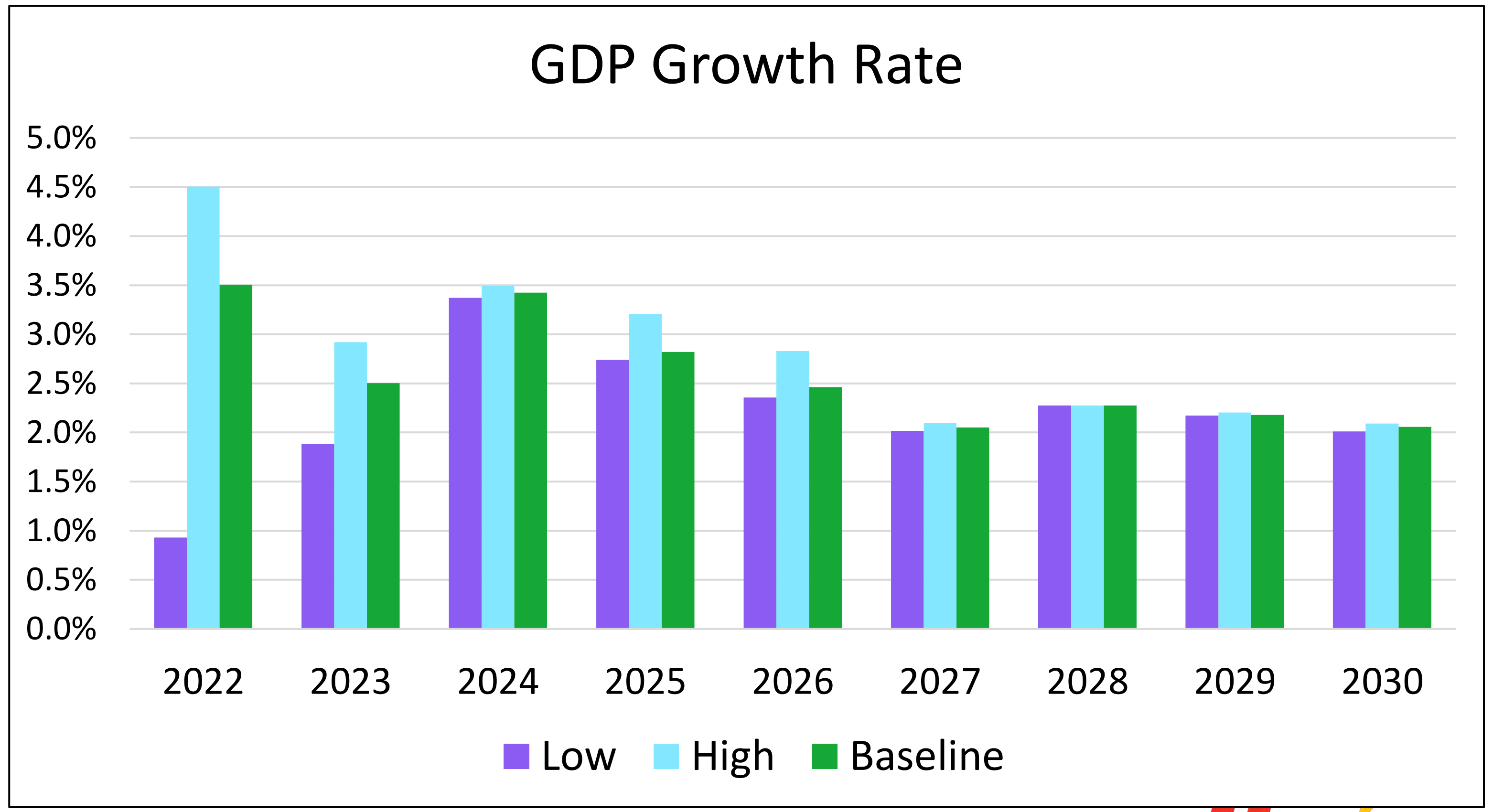
→ Moody Analytics scenarios growth rates are noticeably different in the near-term but revert back to long-term growth rates.

C&I Economic Drivers



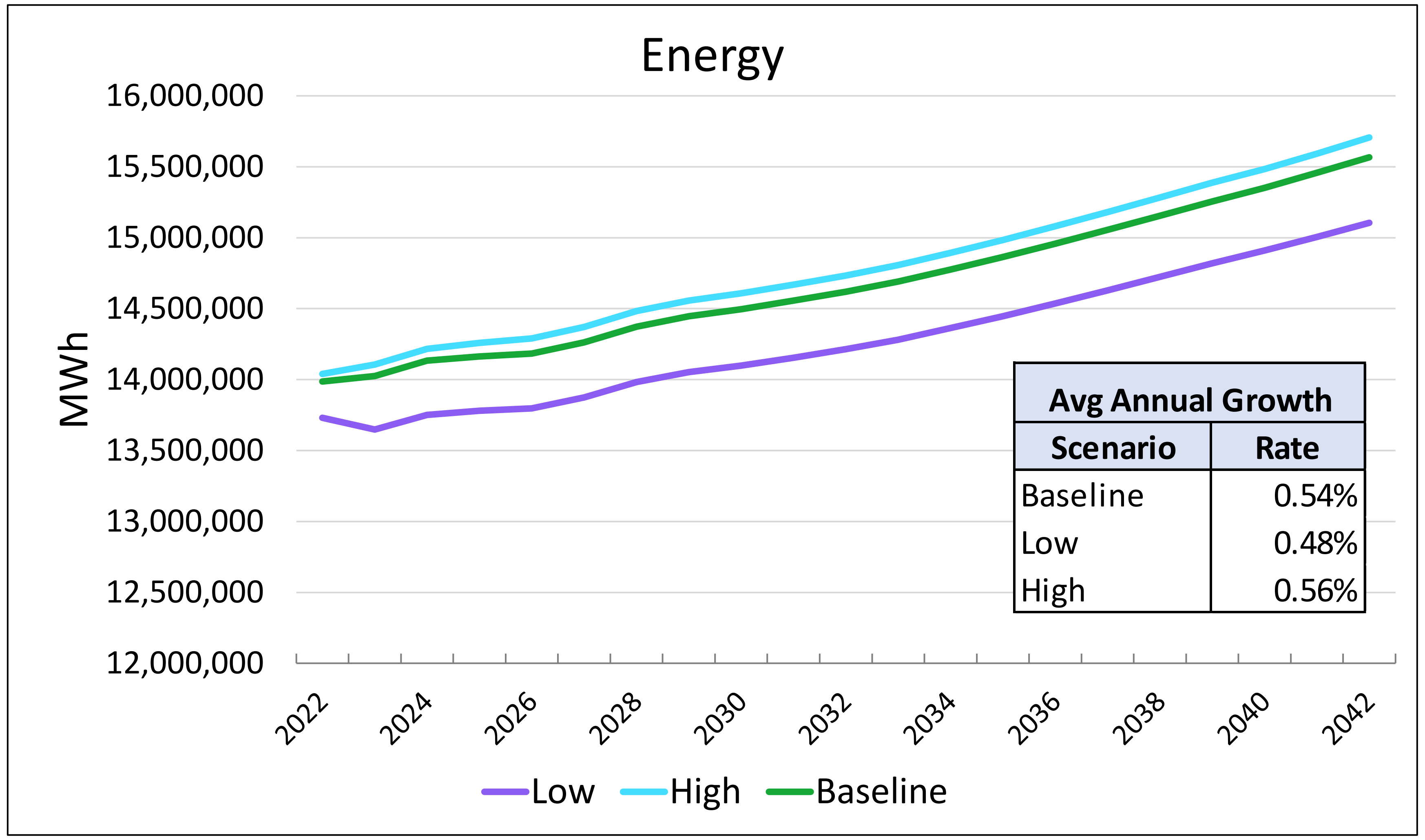




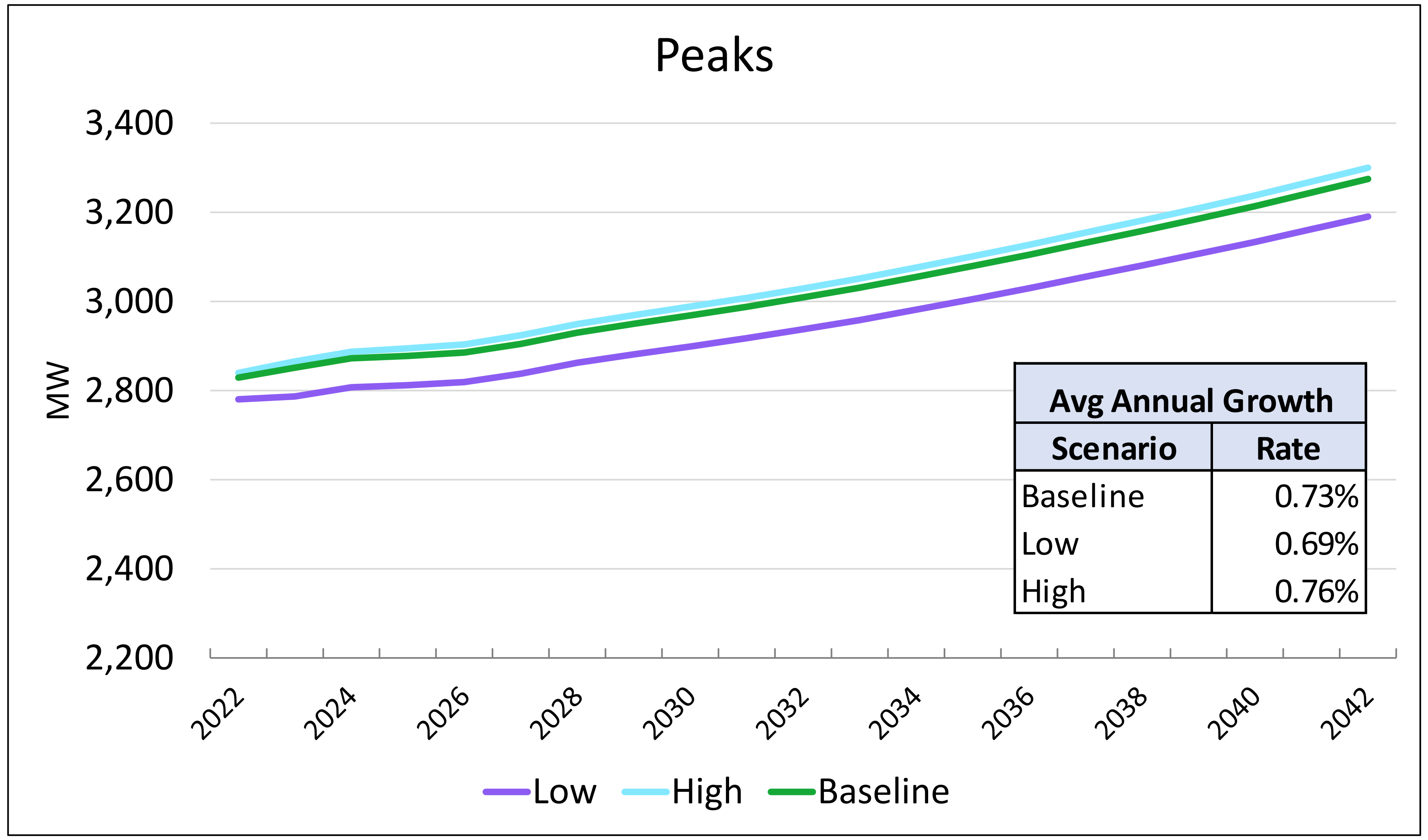


Forecast Scenarios

Energy & Peak Forecast



Avg Annual Growth	
Scenario	Rate
Baseline	0.54%
Low	0.48%
High	0.56%



Avg Annual Growth	
Scenario	Rate
Baseline	0.73%
Low	0.69%
High	0.76%

- Models updated to include actuals through Dec 2021
- Forecasts excludes energy efficiency programs (EE), electric vehicles, and solar impact
- Low forecast results in a reduction of 461,928 MWh and 84 MW by 2042
- High forecast results in an increase of 139,270 MWh and 26 MW by 2042

2022 Integrated Resource Plan (IRP)

DSM Market Potential Study Introduction

Presented by IRP Partners

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

brightline
GROUP

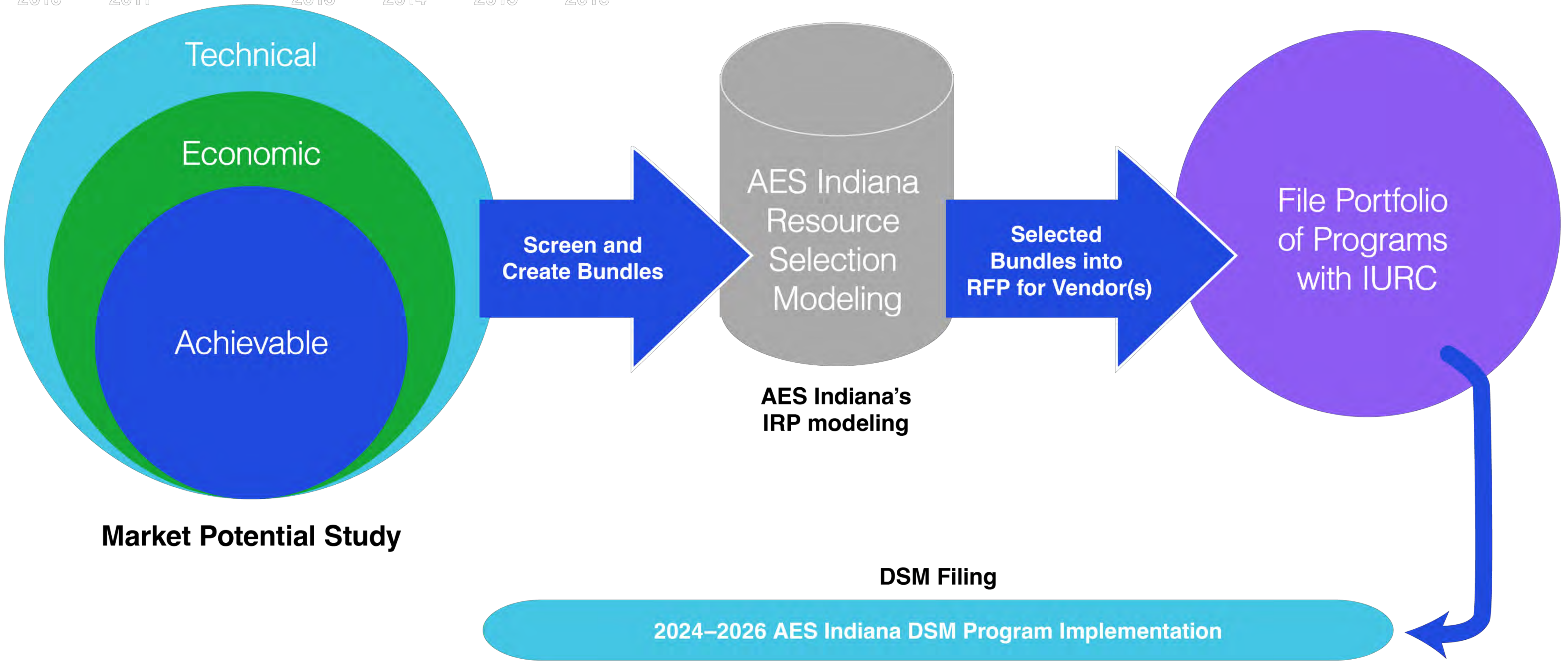
aes Indiana

MPS Results & DSM Resources

aes Indiana

Introduction to the DSM Process in the IRP

IURC Rules – 170 IAC 4-7-8-c-4
“Analysis showing Supply-side resources and demand-side resources have been evaluated on a consistent and comparable basis.”



Agenda

- → MPS Recap
- → Energy Efficiency Potential
  - Overview of results
  - Sector-level results
  - Program potential
- → Demand Response Potential
  - Overview of results
  - Sector-level results
- → Developing DSM IRP Inputs

AES Indiana

DSM Market Potential Study

MPS Recap

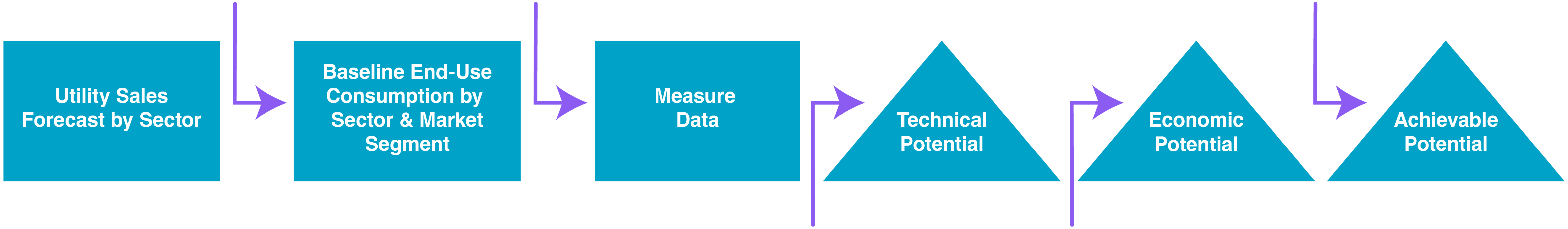
Jeffrey Huber, Overall Project Manager and MPS Lead, GDS Associates

Overall Market Potential Study Process

LOAD DISAGGREGATION
Sales by Market Segment
Consumption by End Use

DATA COLLECTION
New & Existing Primary Data,
Secondary Data Collection

MARKET ADOPTION
Historical Performance Short-term
and Long-term Market Barriers



TECHNOLOGY CHARACTERISTICS
Energy, Capacity, and Therm Unit Savings
Saturation Shares Codes and Standard
Updates Applicability Interactions

COST-EFFECTIVENESS
Load Shapes Avoided Cost Benefits
Measure Costs/Price Trends

Energy Efficiency Potential Types

TECHNICAL POTENTIAL

All technically feasible measures are incorporated to provide a theoretical maximum potential.

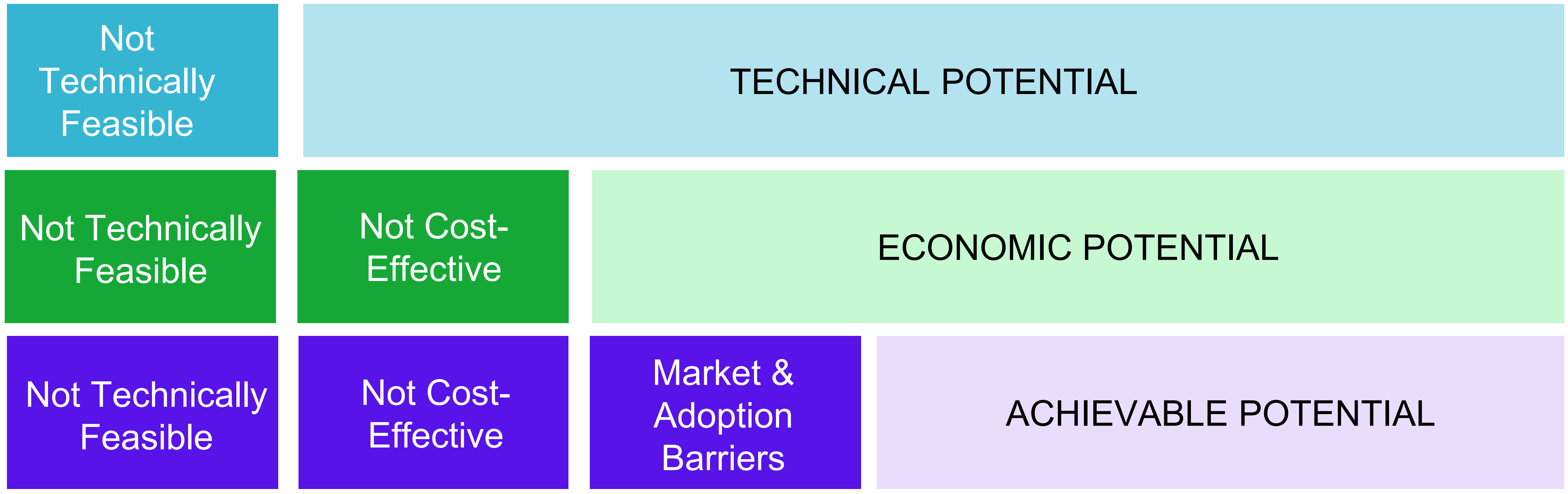
ECONOMIC POTENTIAL

All measures are screened for cost-effectiveness using the UCT Test. Only cost-effective measures are included.

ACHIEVABLE POTENTIAL

Cost-effective energy efficiency potential that can practically be attained in a real-world program delivery case, assuming that a certain level of market penetration can be attained.

Types of Energy Efficiency Potential



MAXIMUM ACHIEVABLE POTENTIAL (MAP)

Incentives set up to 100% of incremental cost

REALISTIC ACHIEVABLE POTENTIAL (RAP)

Incentives based on historical levels

GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

Key Methodological Assumptions for MAP/RAP

01 Adoption Rates

Method for determining both the short-term and long-term adoption levels by key market segments

02 Incentives

Historical incentives are a key driver of the Realistic Achievable Potential (RAP) scenario

03 Non-Incentive Costs

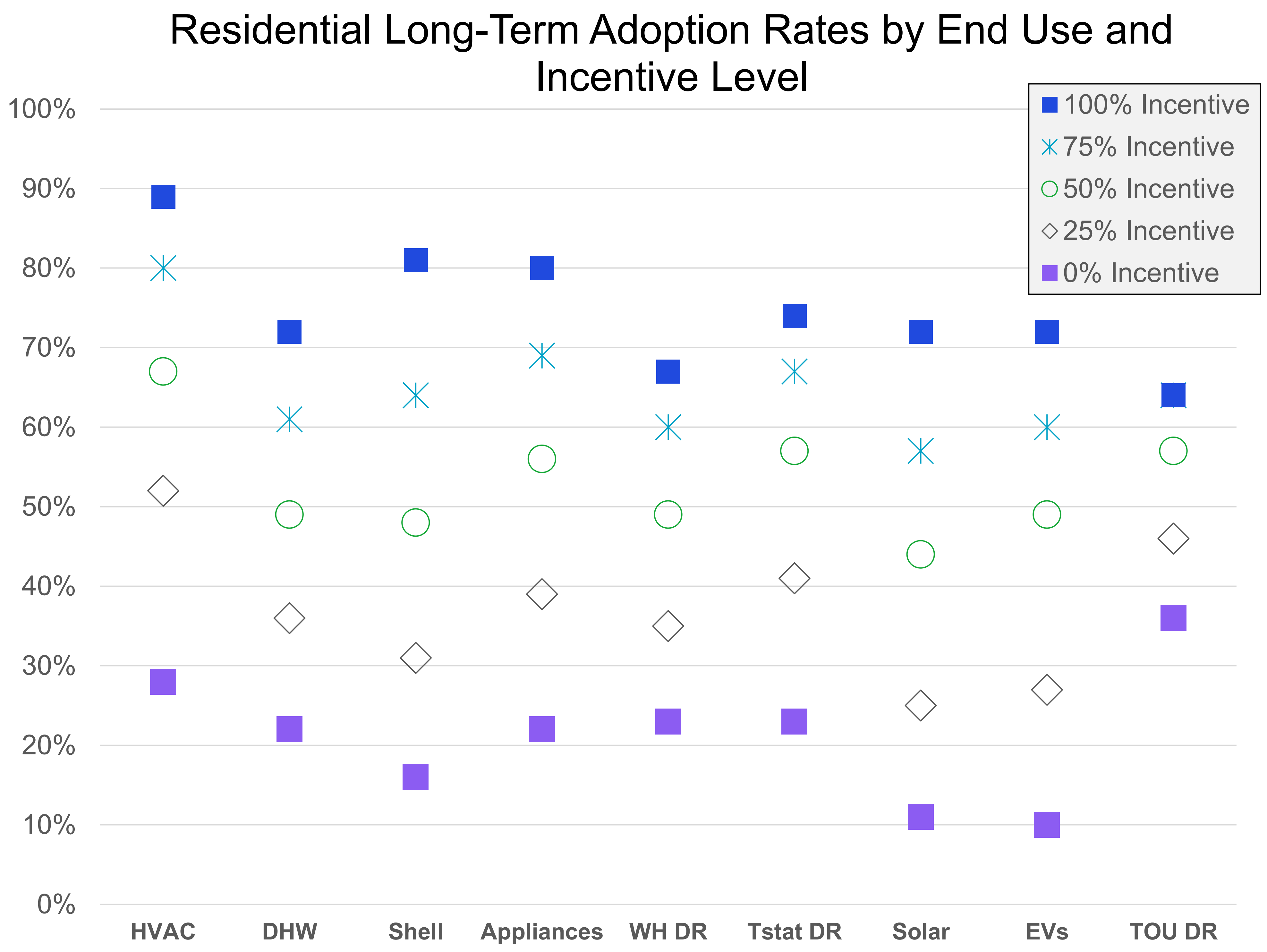
Non-Incentive costs are included at both the MAP/RAP level

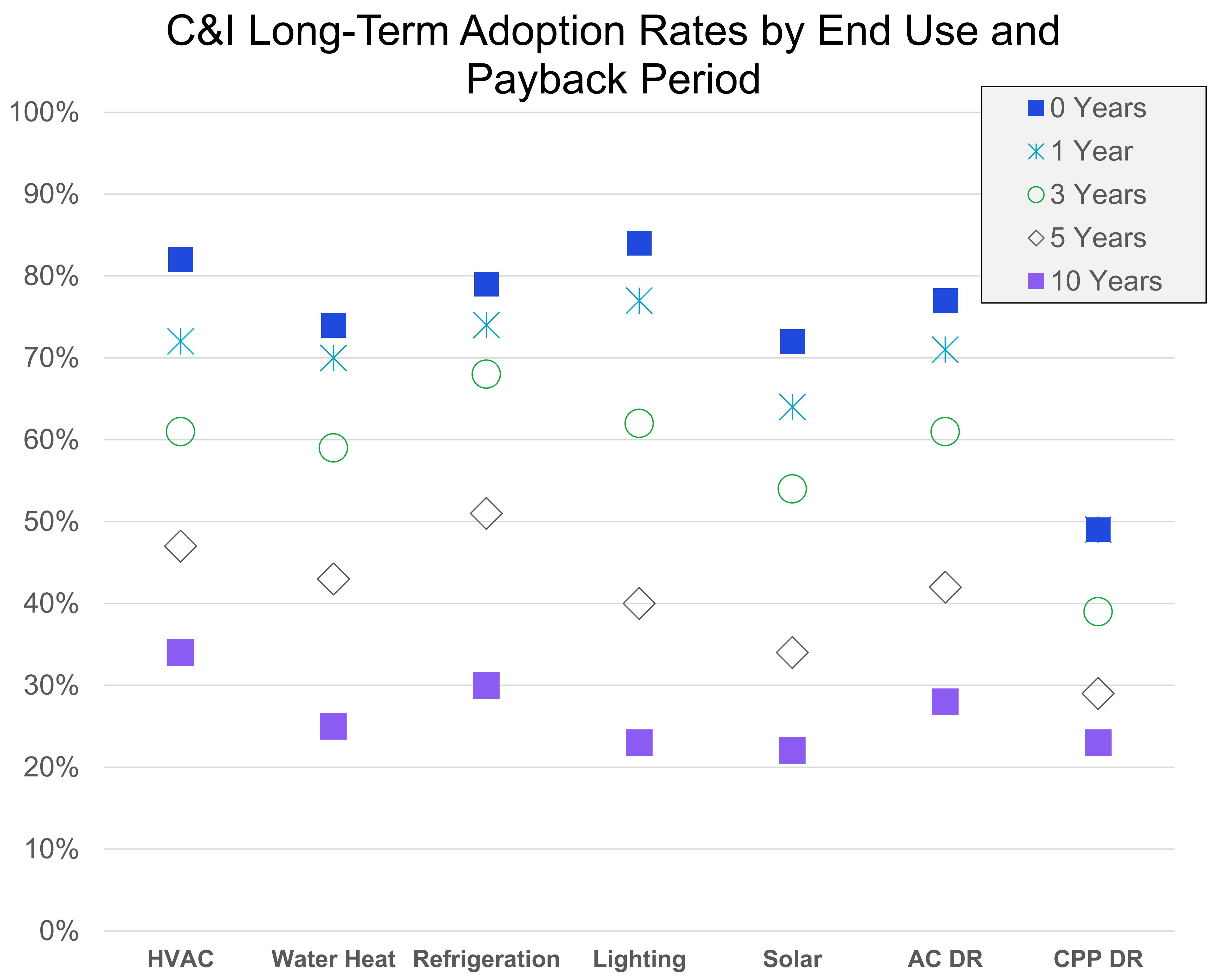
04 Program Mapping & NTG

Evaluated NTG results were incorporated to assess Program RAP

GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

Willingness to Participate (WTP) Results





*** WTP data gives an indication of the relationship between utility intervention and customer acceptance/adoption of EE technologies*

GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

DSM Market Potential Study Results

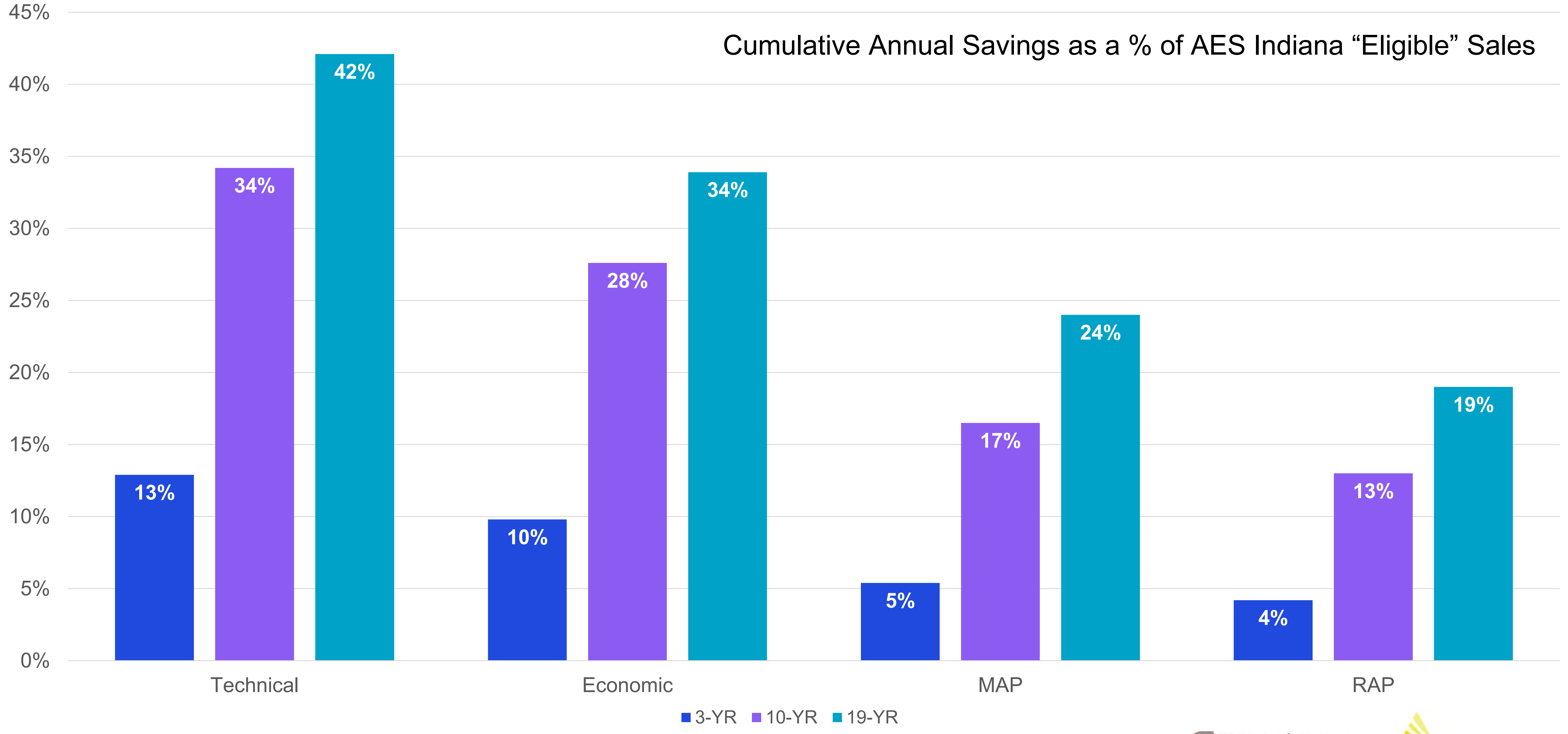
Energy Efficiency (EE) Potential

Initial Comments

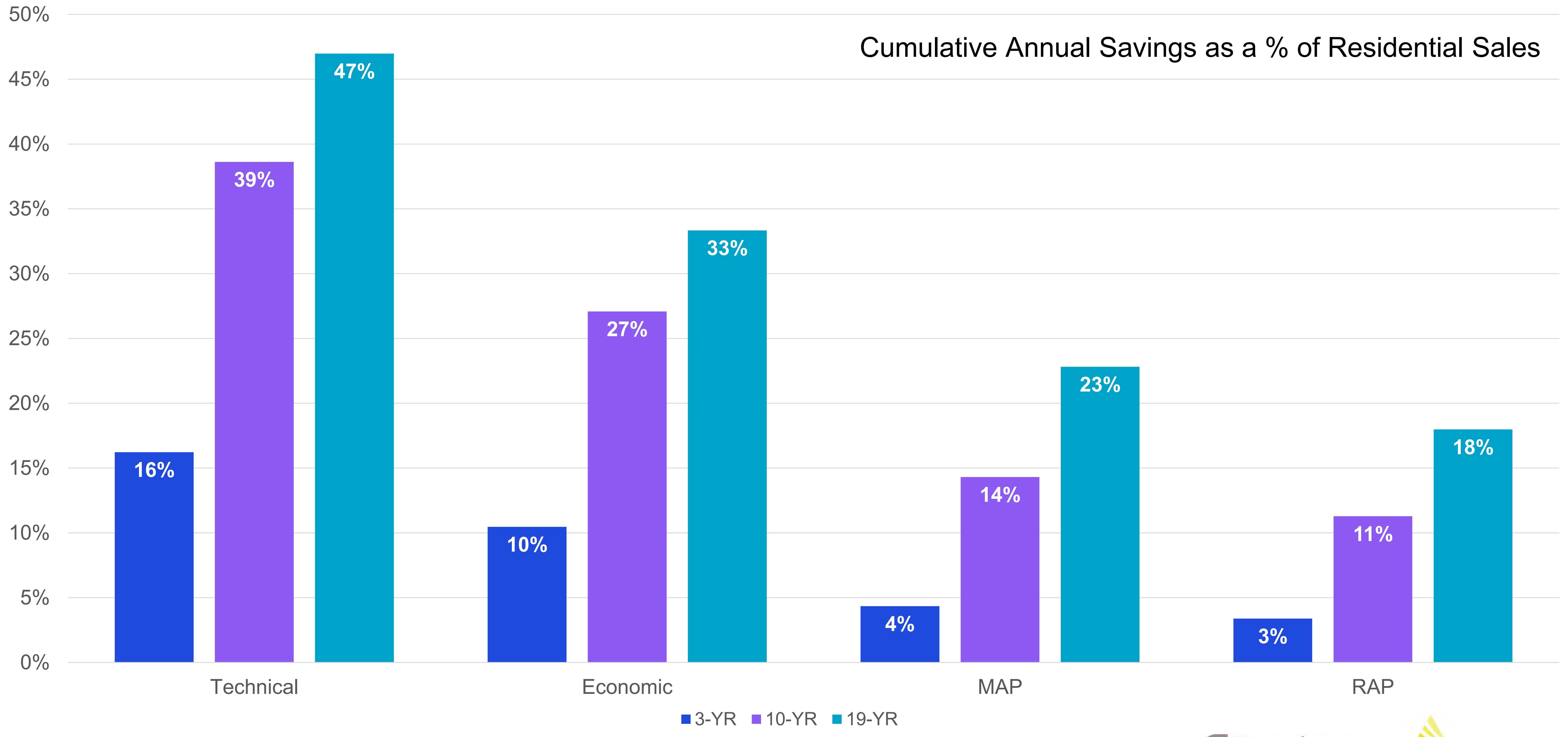
Overall Comments (all sectors):

- All savings are gross
- Economic Screening is the UCT Test using current incentive levels and no administrative costs
- Measure assumptions (savings / costs) are based on a review of current evaluated savings as well as savings from approved sources (i.e., EM&V results, Illinois TRM, MEMD, etc.)
- Technical & Economic potential is a phased-in potential; *i.e. opportunities are dependent on stock turnover*
- RAP scenario is based on current incentive levels and associated long-term adoption rates (informed by primary market research)
- MAP scenario examines ability to move incentive levels higher than historical; *does not examine lowering incentives for measures that do not currently screen as cost-effective.*

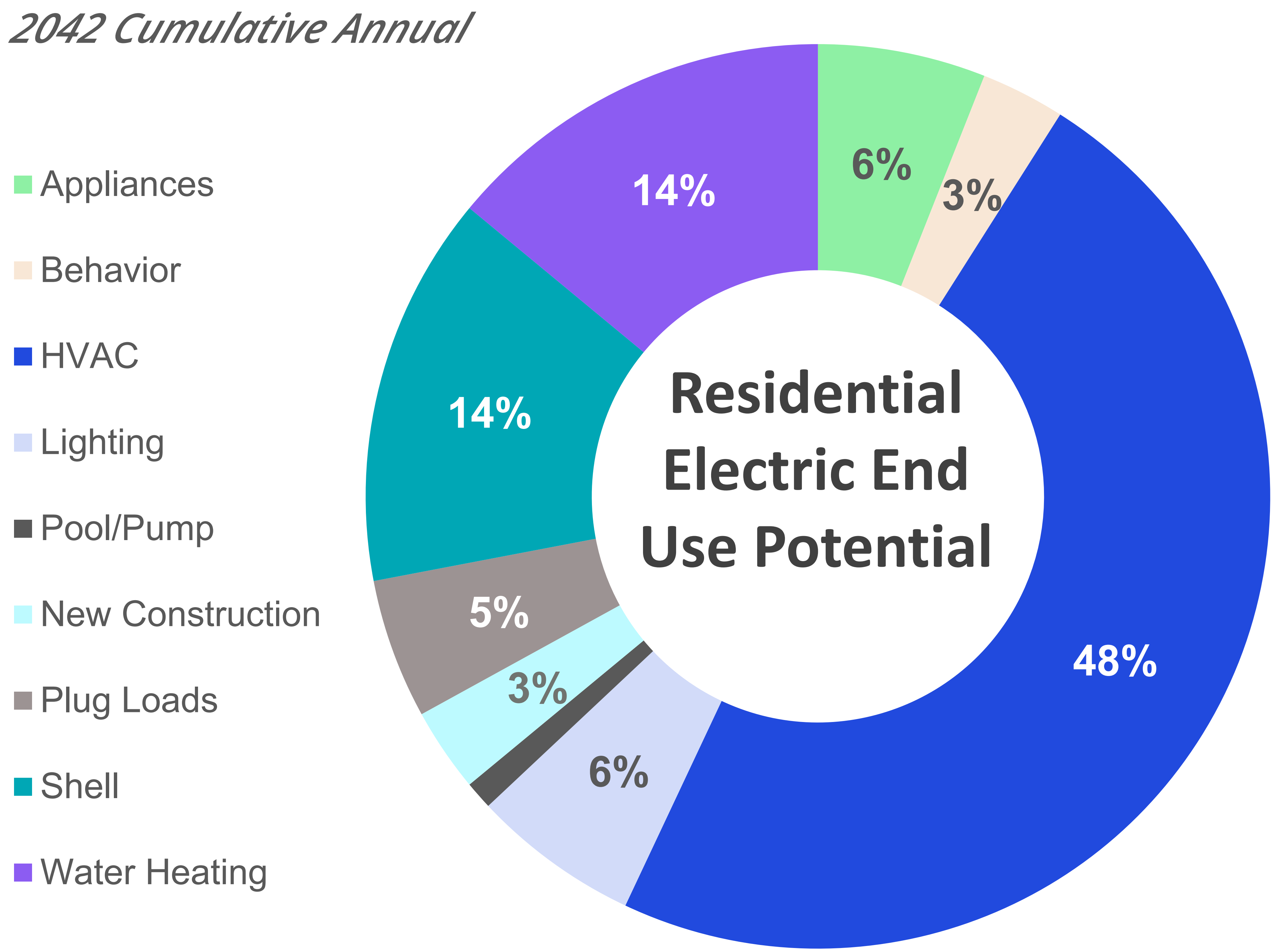
Overview of Results – Cumulative Annual



Residential Sector Results



Residential Maximum Achievable Potential (MAP)



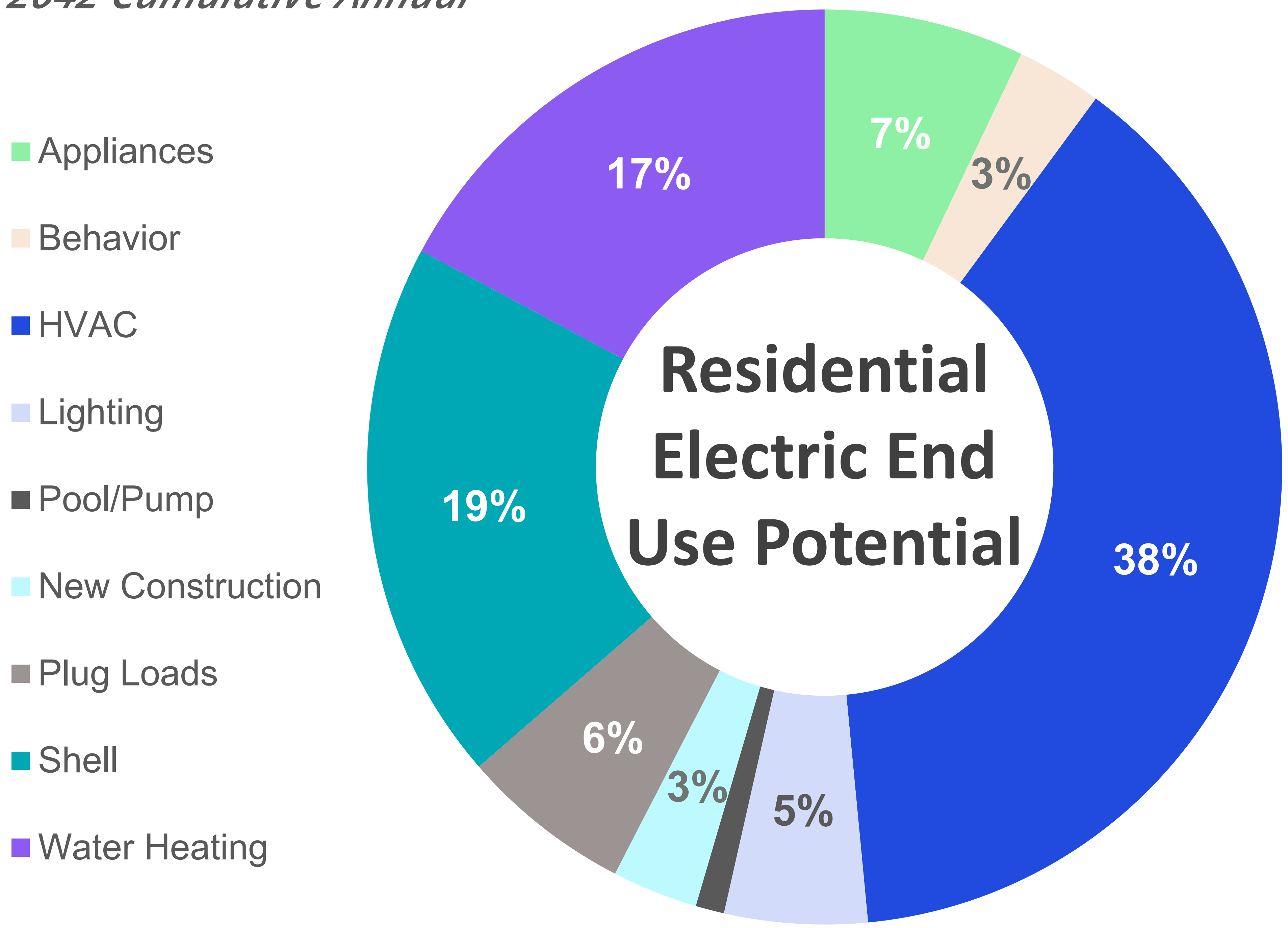
23%

Residential cumulative annual maximum achievable potential as a percentage of forecasted sales in 2042

(compared to 35% by 2039 in 2019 MPS; difference attributable to lower economic potential, updated saturation data and adoption rates)

Residential Realistic Achievable Potential (RAP)

2042 Cumulative Annual

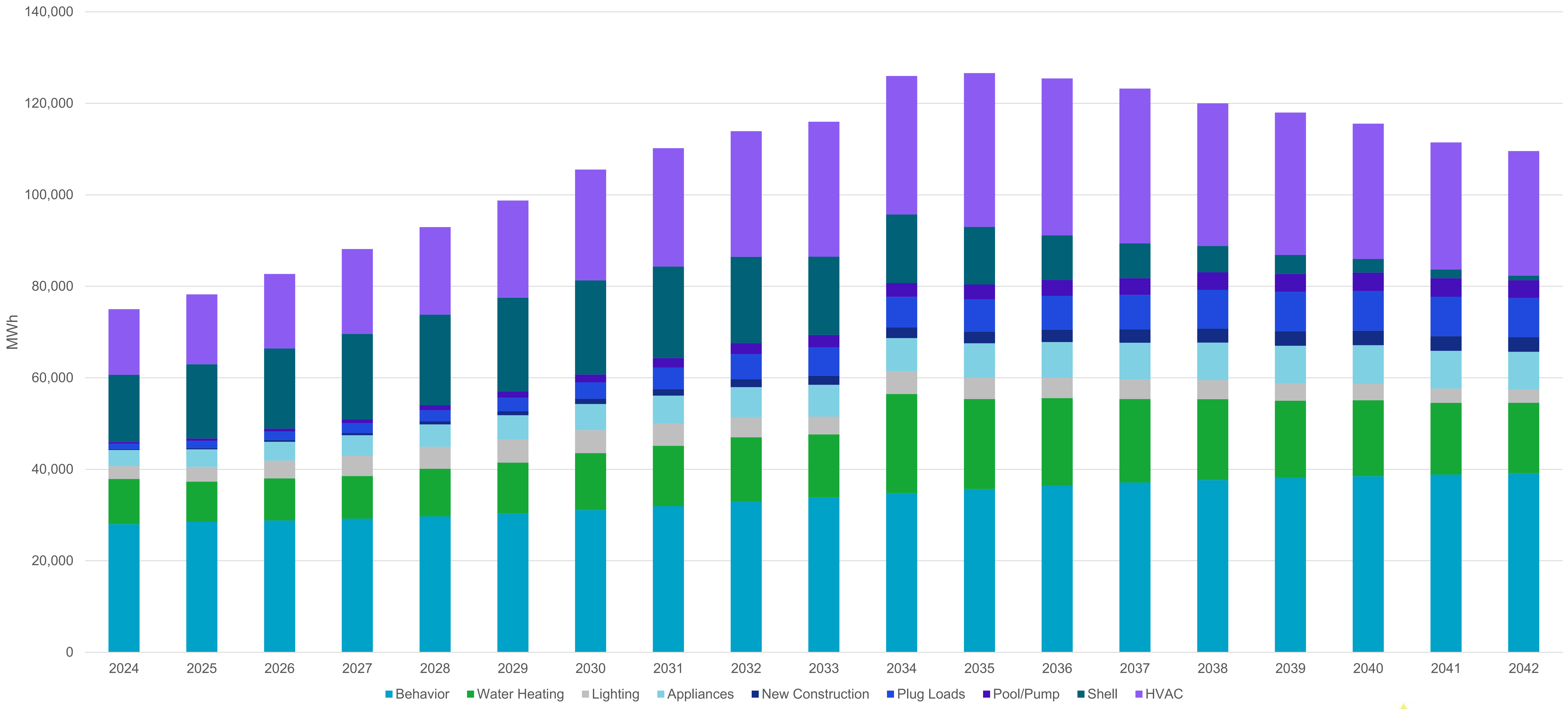


18%

Residential cumulative annual realistic achievable potential as a percentage of forecasted sales in 2042

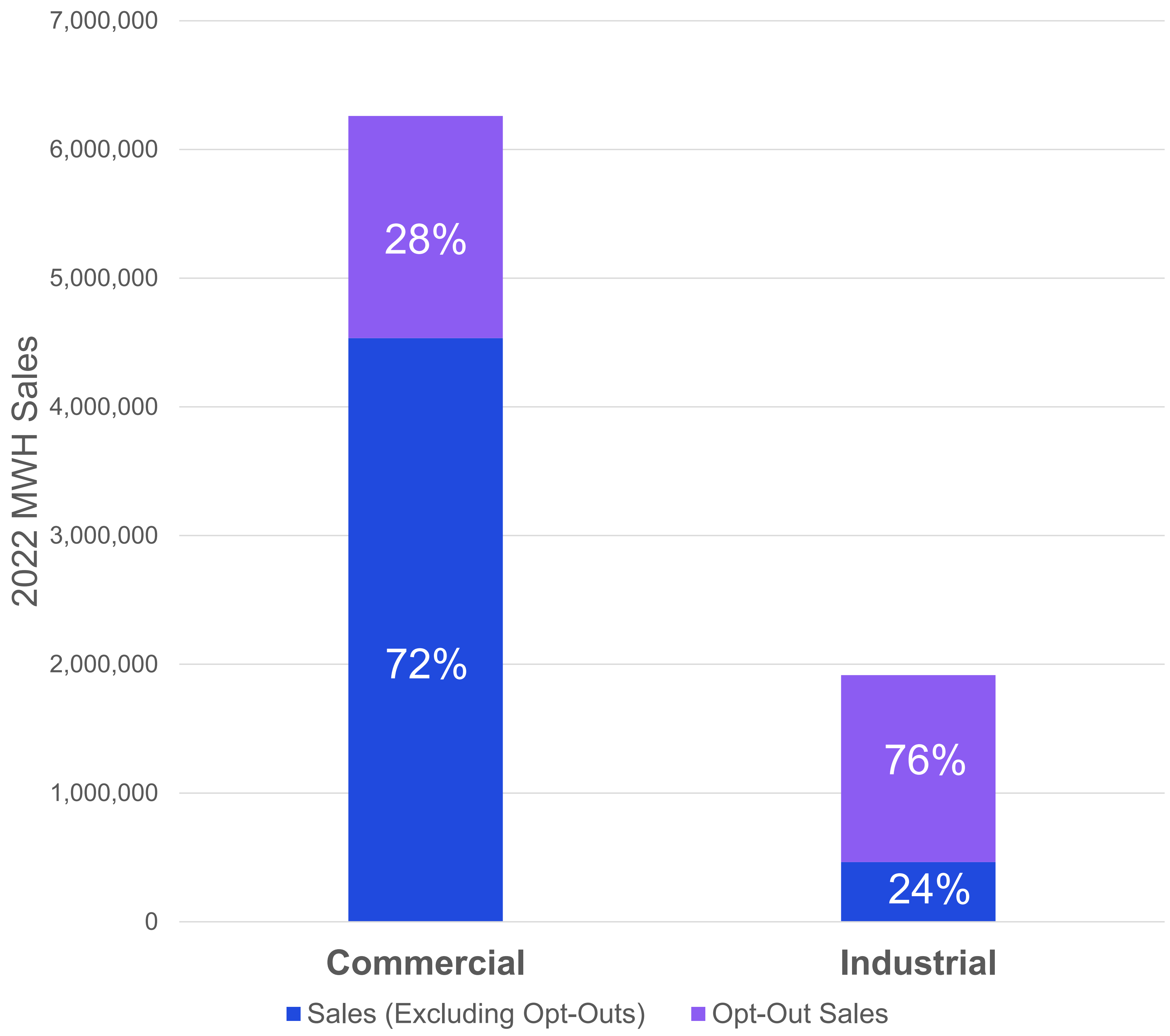
(compared to 24% by 2039 in 2019 MPS; difference attributable to lower economic potential, updated saturation data and adoption rates)

Residential Incremental Annual Savings by End Use



GDS Associates, Inc. ENGINEERS & CONSULTANTS
brightline GROUP
aes Indiana

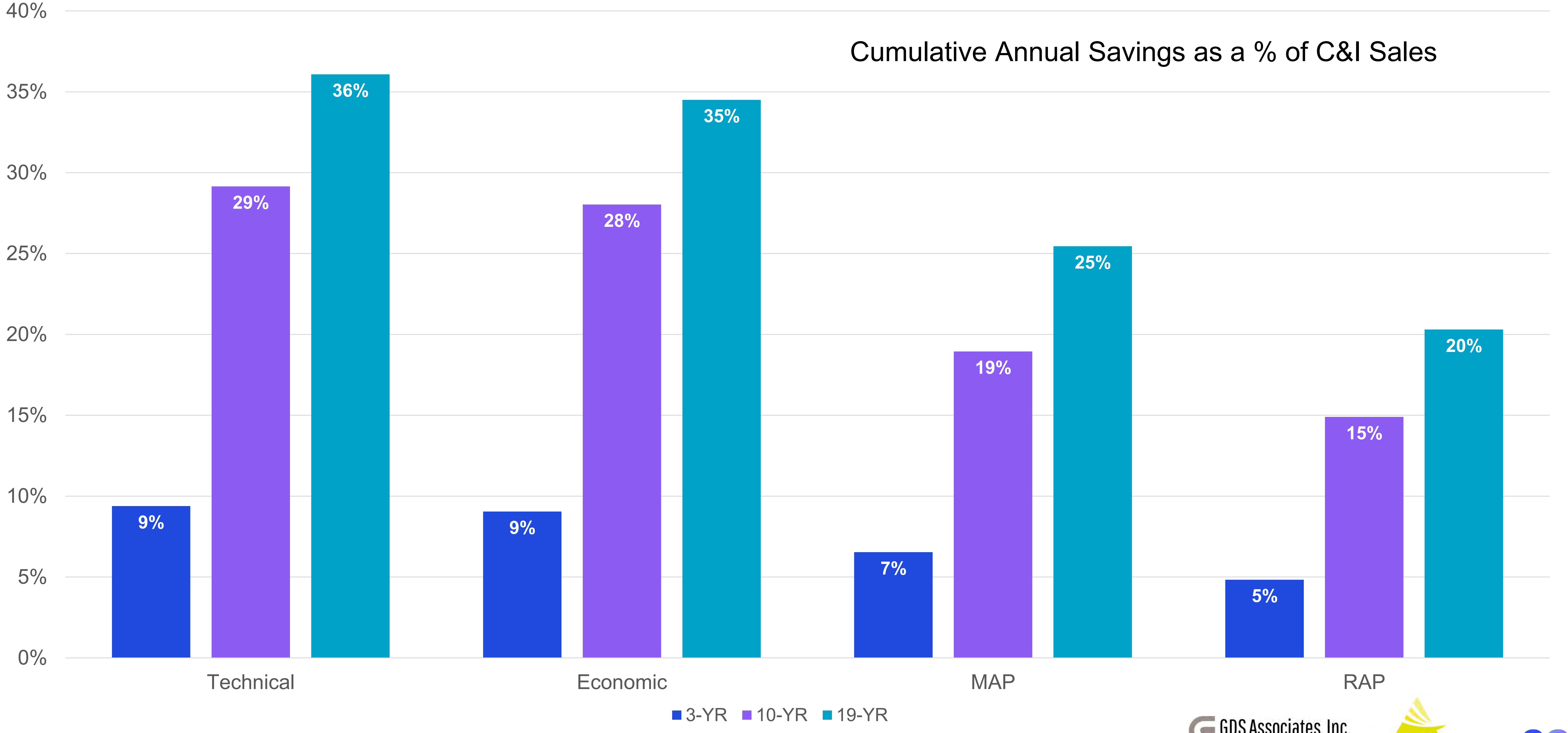
C&I Opt-Outs



C&I "Opt-Out Sales" Adjustment

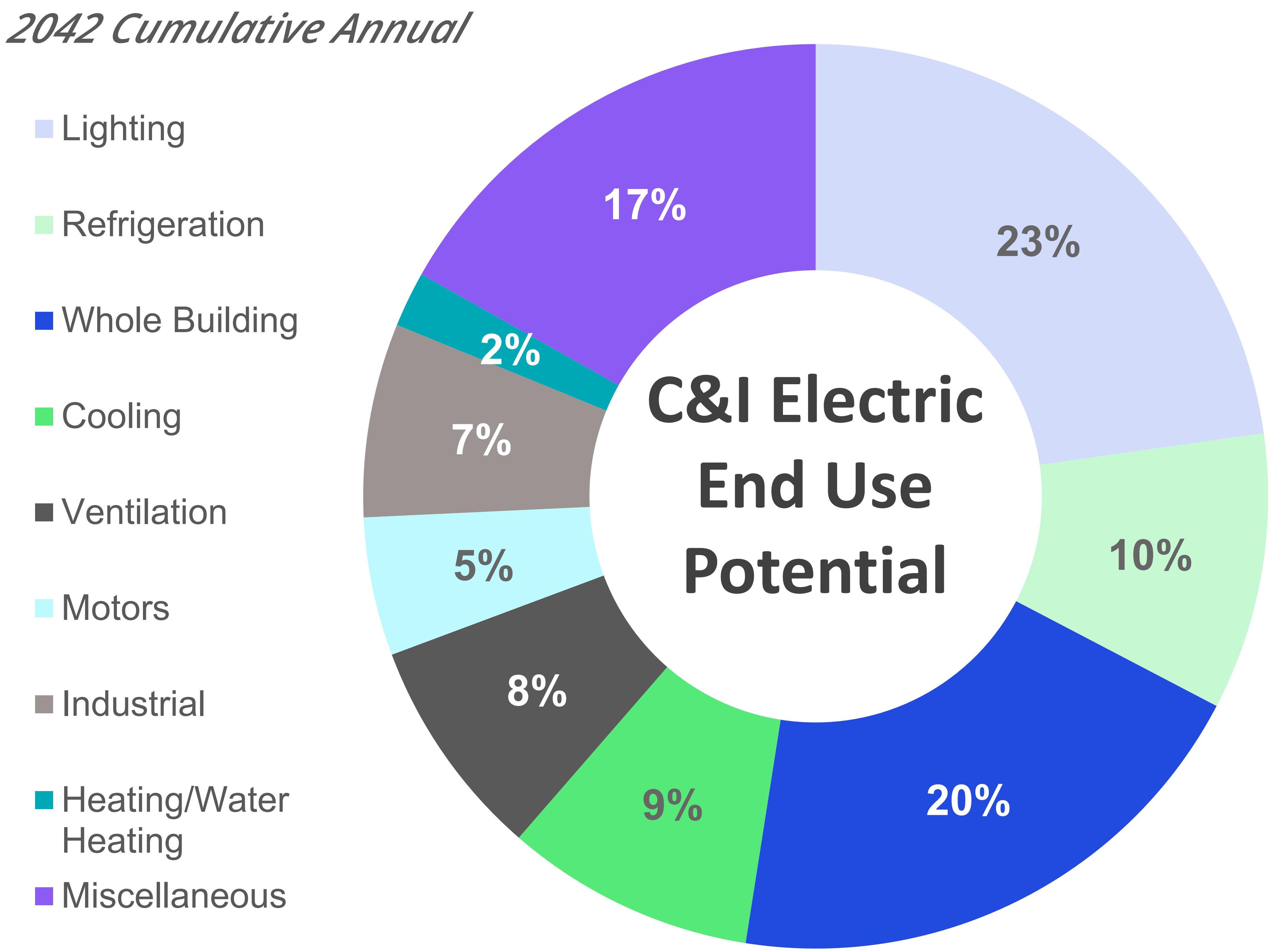
- MPS uses only "eligible" sales for electric energy efficiency potential, removing sales from C&I customers who opt-out of the energy efficiency rider.
- 28% of Commercial Sales were from opt-out customers in 2022
- 76% of Industrial Sales were from opt-out customers in 2022
- Savings (as a % of sales) are relative to "eligible" sales in subsequent slides

C&I Sector Results



GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

C&I Maximum Achievable Potential (MAP)



25%

C&I cumulative annual maximum achievable potential as a percentage of forecasted sales in 2042

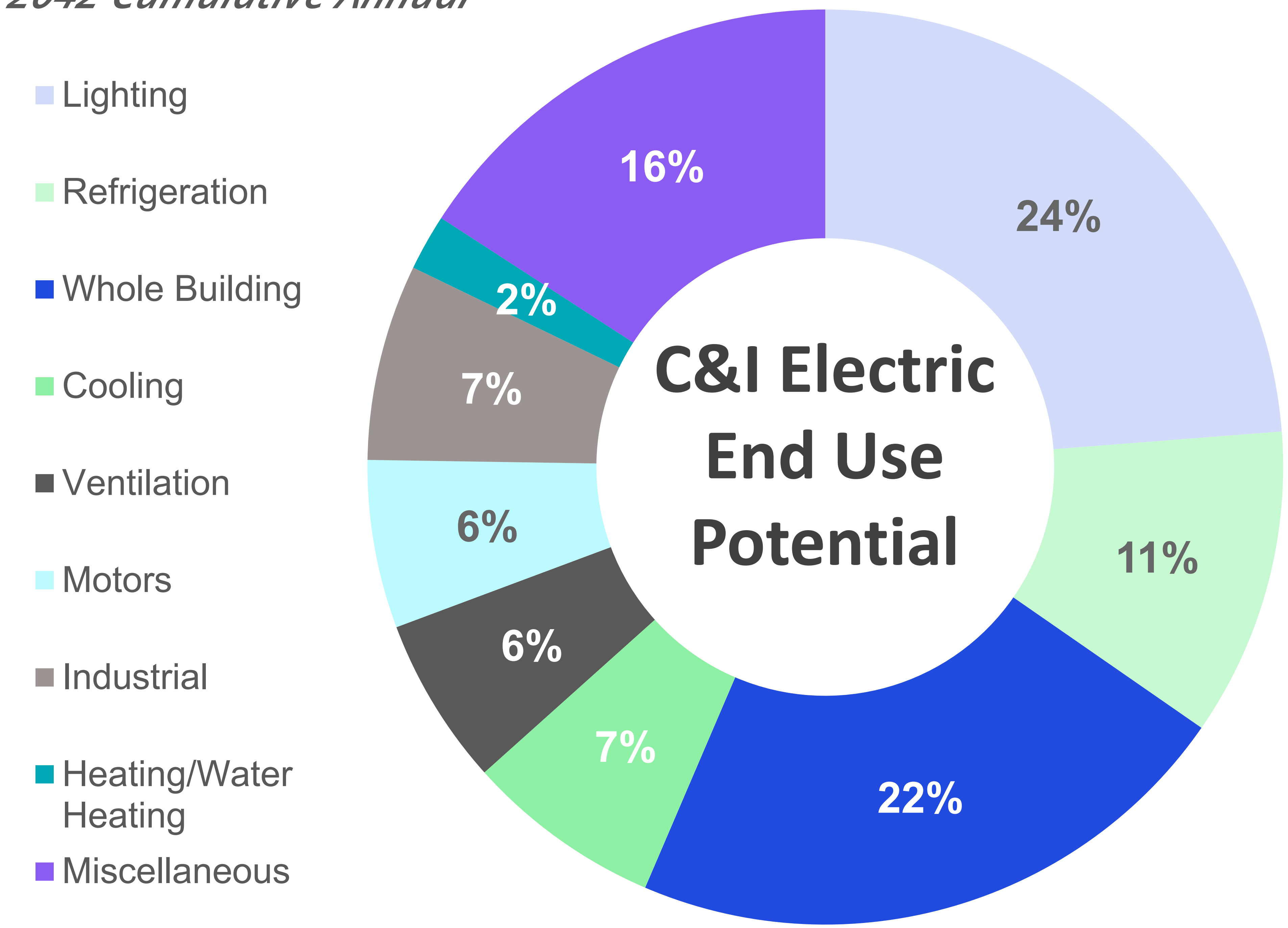
(compared to 36% by 2039 in 2019 MPS ; primary difference in assumed MAP incentive assumptions and associated adoption levels)

***Other includes potential associated with cooking, compressed air, behavioral and other miscellaneous loads (elevators, vending machines, etc.)*

GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

C&I Realistic Achievable Potential (RAP)

2042 Cumulative Annual



20%

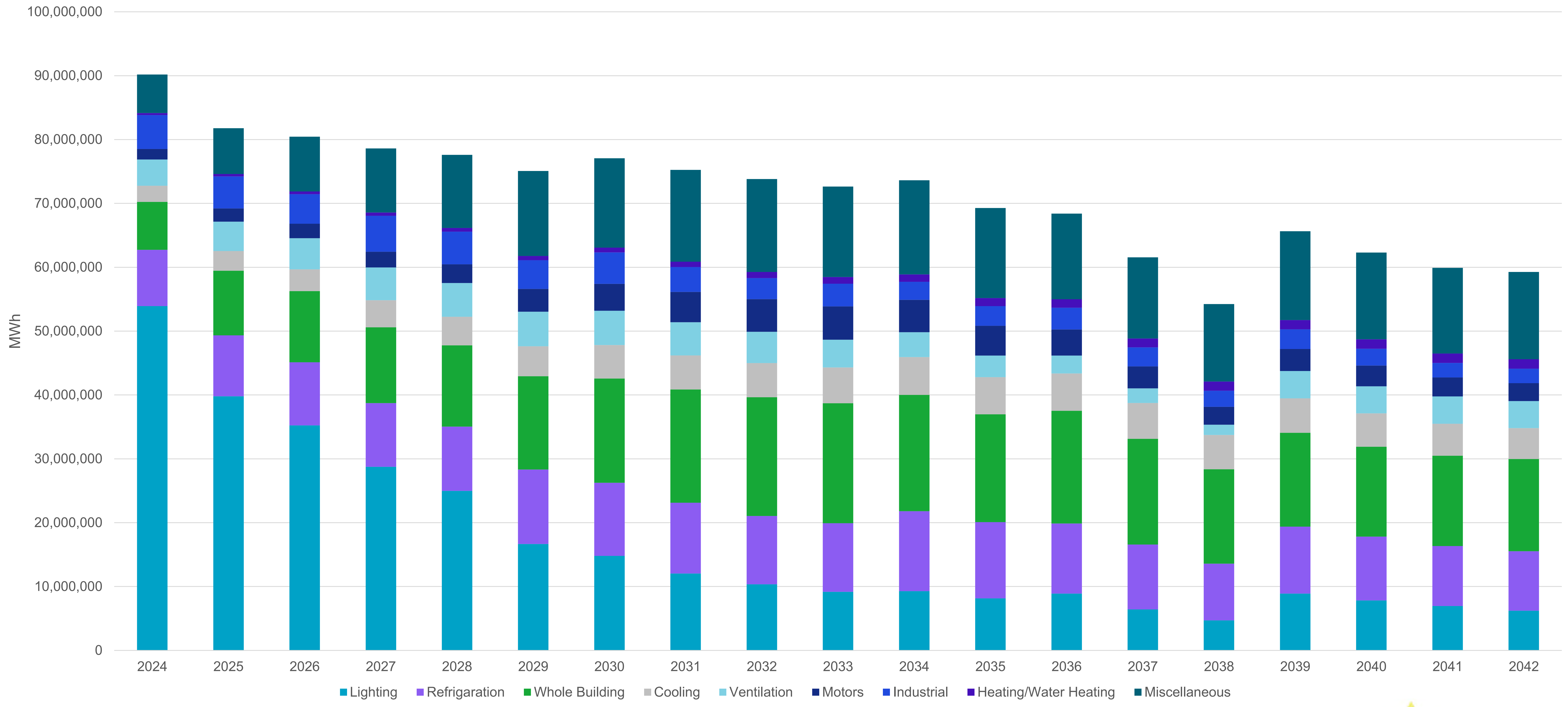
C&I cumulative annual maximum achievable potential as a percentage of forecasted sales in 2042

(compared to 19% by 2039 in 2019 MPS)

***Other includes potential associated with cooking, compressed air, behavioral and other miscellaneous loads (elevators, vending machines, etc.)*

GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

C&I Incremental Annual Savings by End Use



GDS Associates, Inc. ENGINEERS & CONSULTANTS
brightline GROUP
aes Indiana

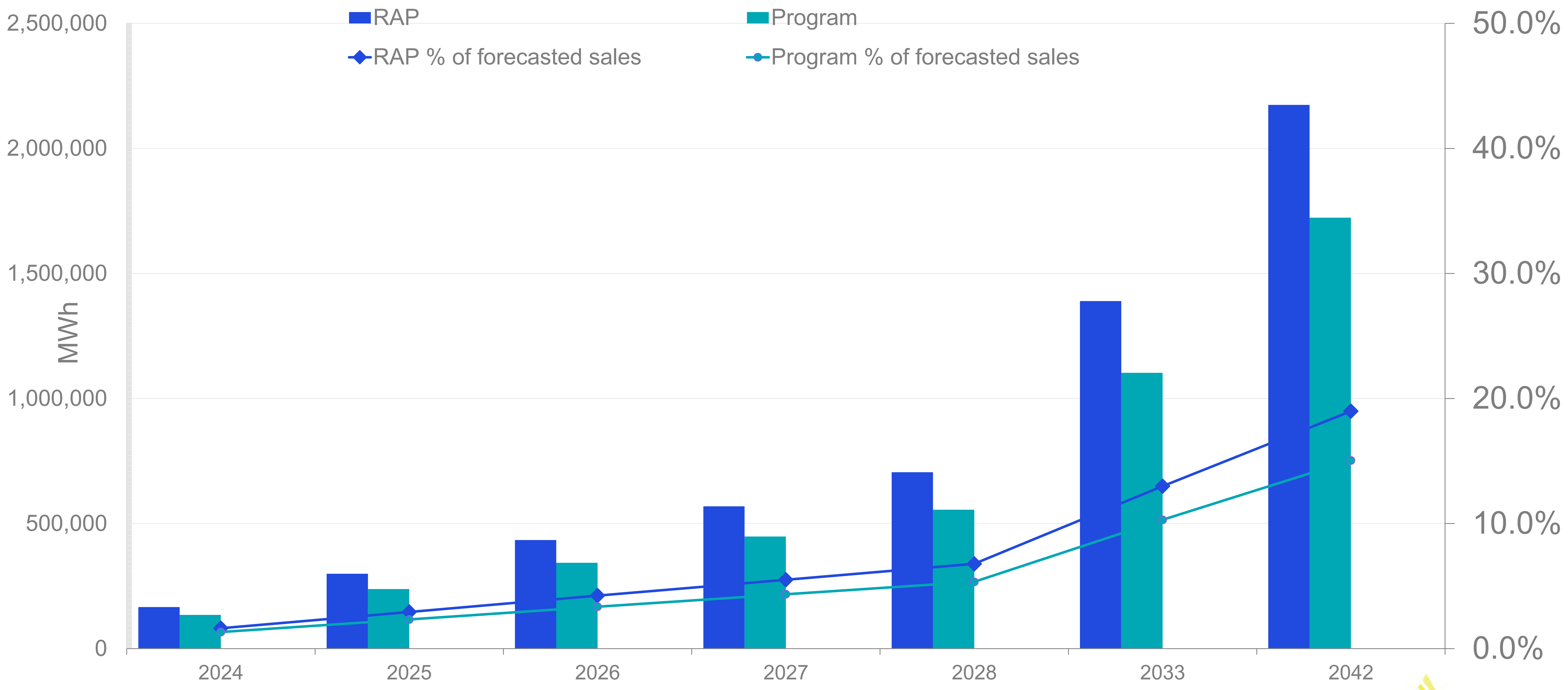
Developing Program Potential from RAP

Key differences between RAP and Program Potential:

Program Potential applies the most recent evaluated net-to-gross (“NTG”) ratios to the RAP (overall reduction due to NTG <1.0).

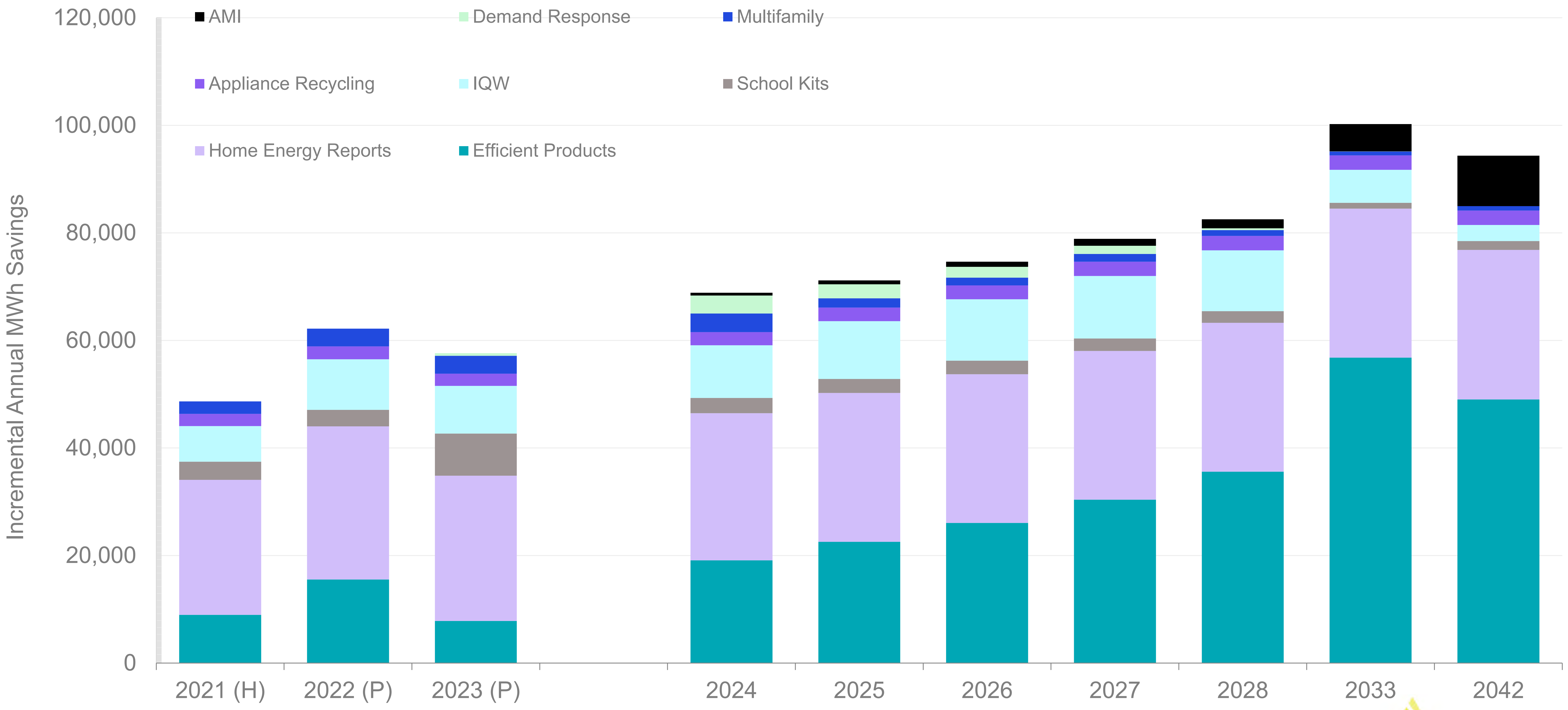
Residential Program	NTG Ratio
Efficient Products	80%
Home Energy Reports	100%
School Kits	63%
Income-Qualified Weatherization	89%
Appliance Recycling	70%
Multifamily	98%
Demand Response	100%
C&I Programs	**NTG Ratio**
Prescriptive	74%
Custom	80%
Strategic Energy Management	100%

Comparison of RAP and Program Potential



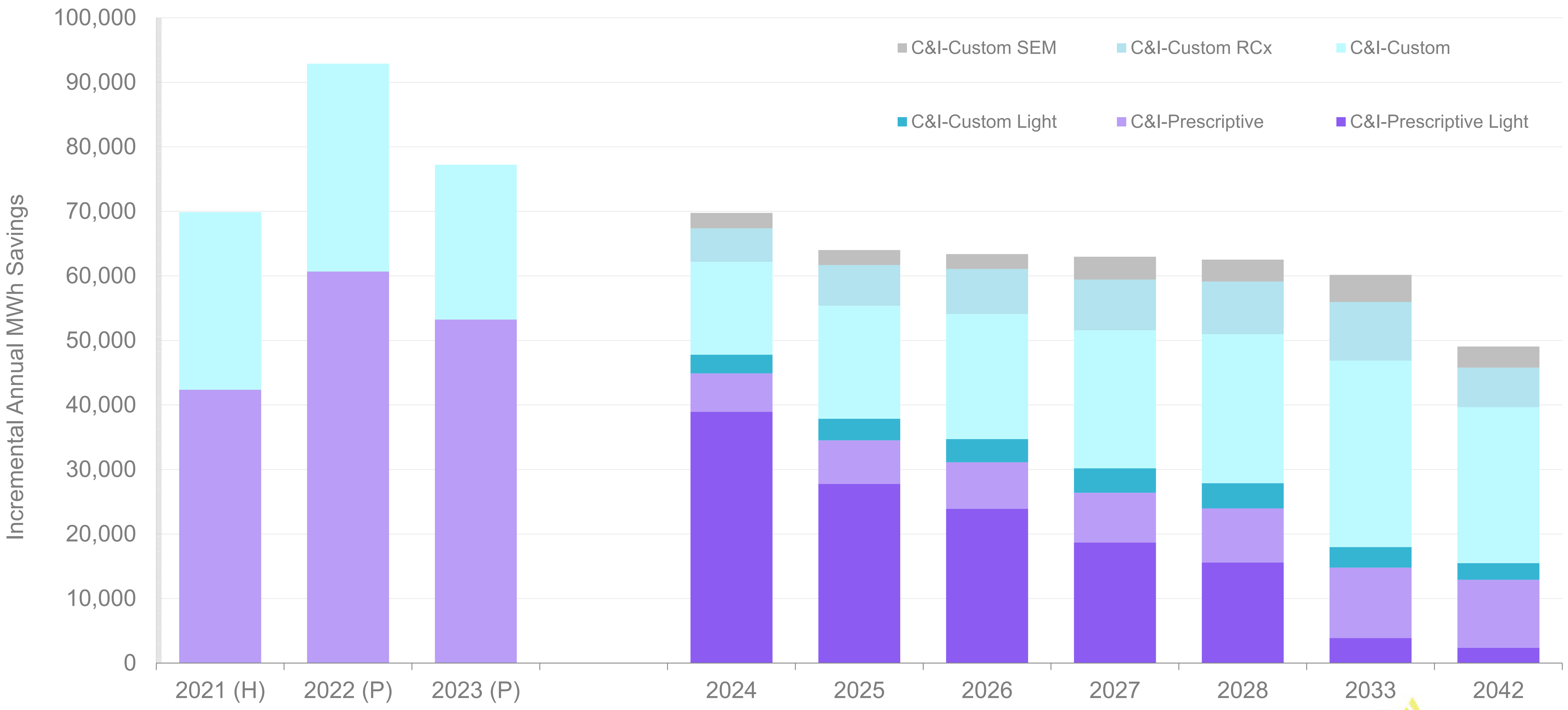
GDS Associates, Inc. ENGINEERS & CONSULTANTS
brightline GROUP
aes Indiana

Annual Residential Program Potential



GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

Annual C&I Program Potential

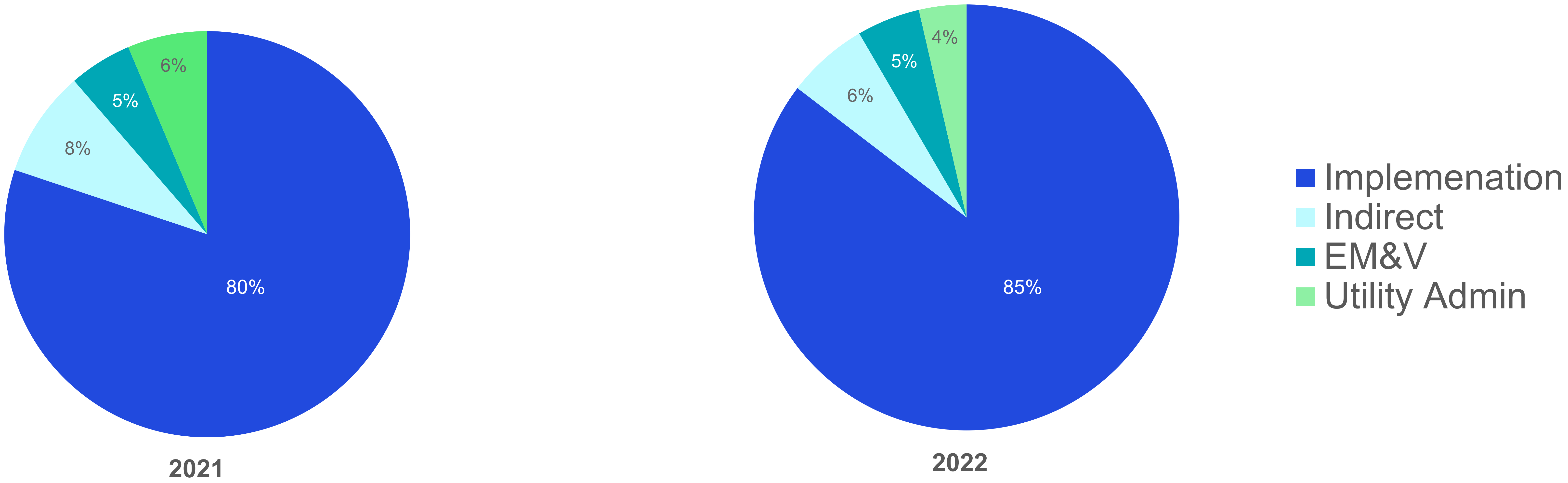


Program Potential Non-Incentive Costs

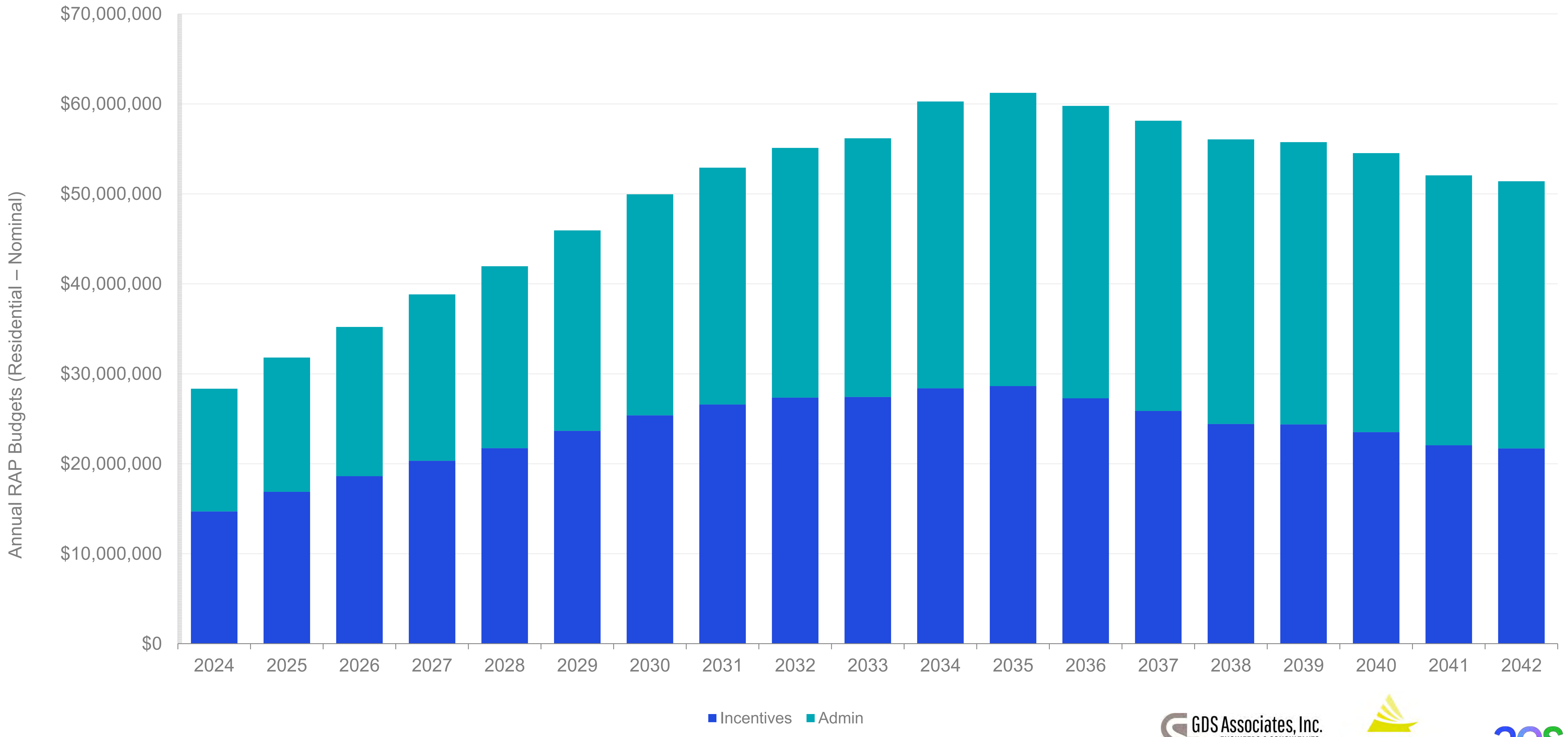
Non-Incentive costs were developed using recent 2021-2022 actual program cost data. Program non-incentive costs were calculated on a gross $ per first-year kWh saved. Non-incentive costs were developed for each sector, and by program when possible.

Historical non-incentive cost categories include:

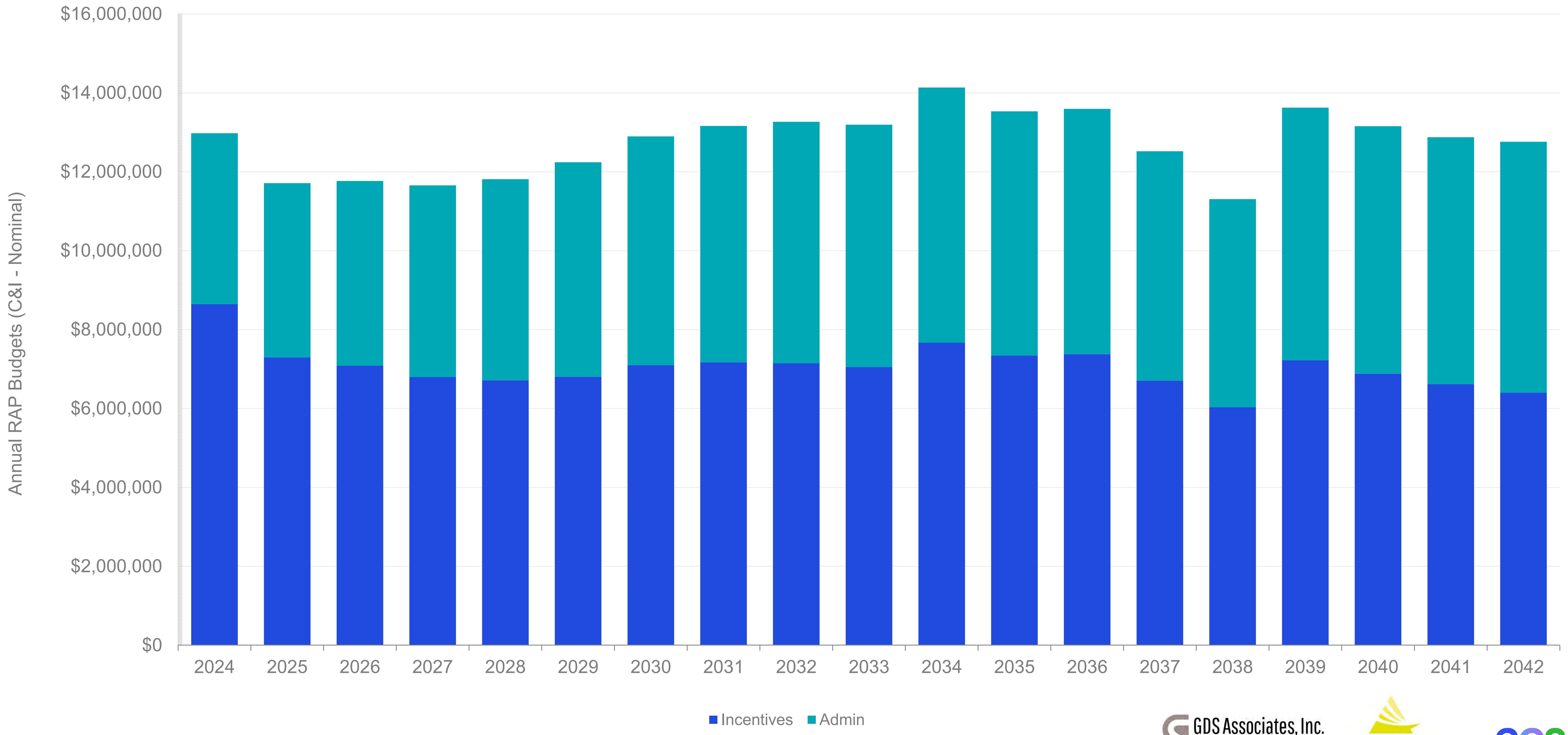
- Implementation
- Utility admin
- Indirect
- EM&V



Residential Program Potential Annual Costs



C&I Program Potential Annual Costs



DSM Market Potential Study Results

Demand Response (DR) Potential

Demand Response Overview

Measures Considered

Demand Response includes Direct Load Control (DLC), Behavior DR, Time of Use (TOU) Rates, Capacity Bidding, Demand Bidding and Interruptible Agreements.

- → In the residential sector, DLC includes central air conditioning, room air conditioning, electric space heating, water heating, smart appliances, and pool pumps
- → In the nonresidential sector, DLC includes air conditioning, electric space heating, lighting, and water heating

DR Hierarchies

DR analysis will account for interactive effects as additional types of demand response programs are added to the mix. The hierarchy for demand response programs in the base case for the four market sectors is as follows:

Residential

1. Direct Load Control
2. Behavior DR
3. TOU

Small C&I

1. Direct Load Control
2. Capacity Bidding
3. TOU

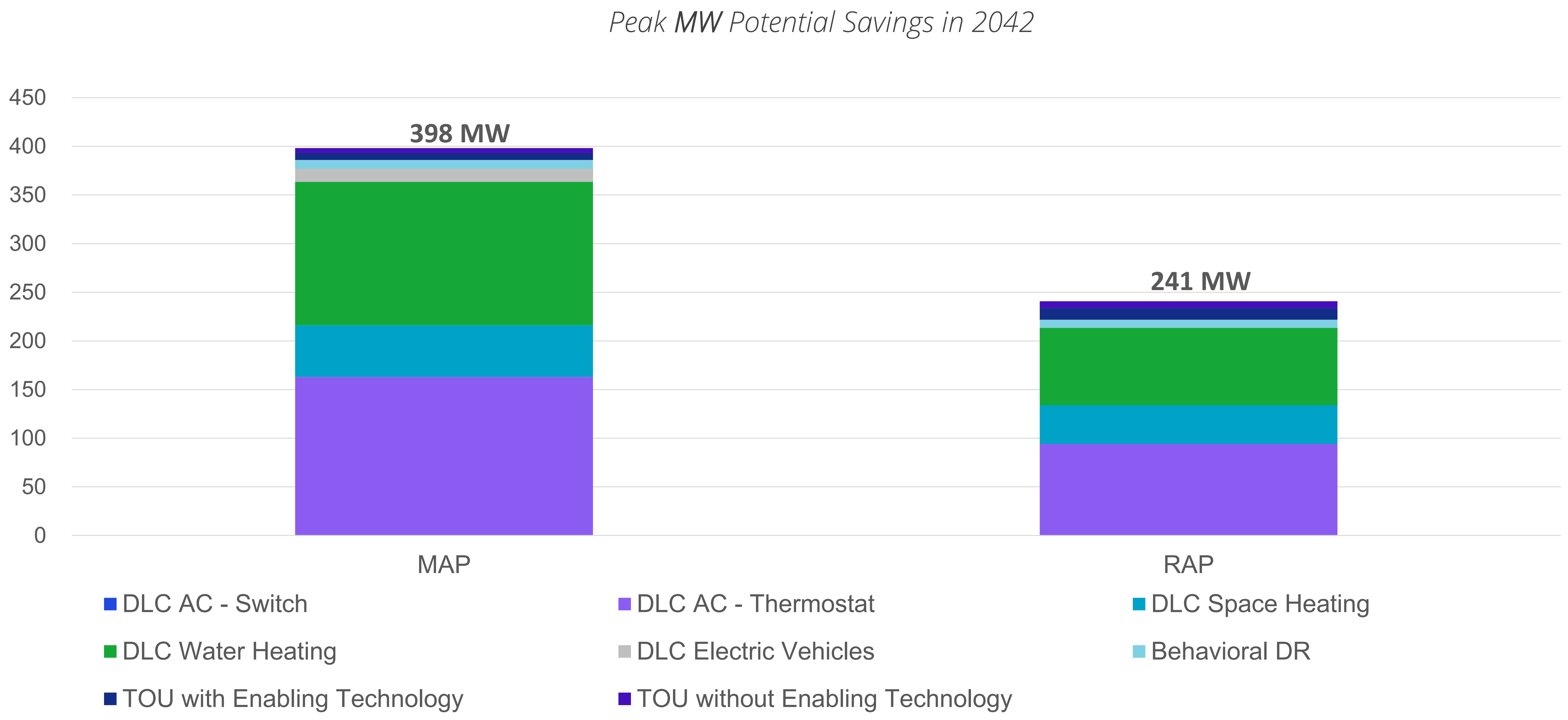
Large C&I

1. Interruptible Agreements
2. Capacity Bidding
3. TOU

Demand Response Programs Considered

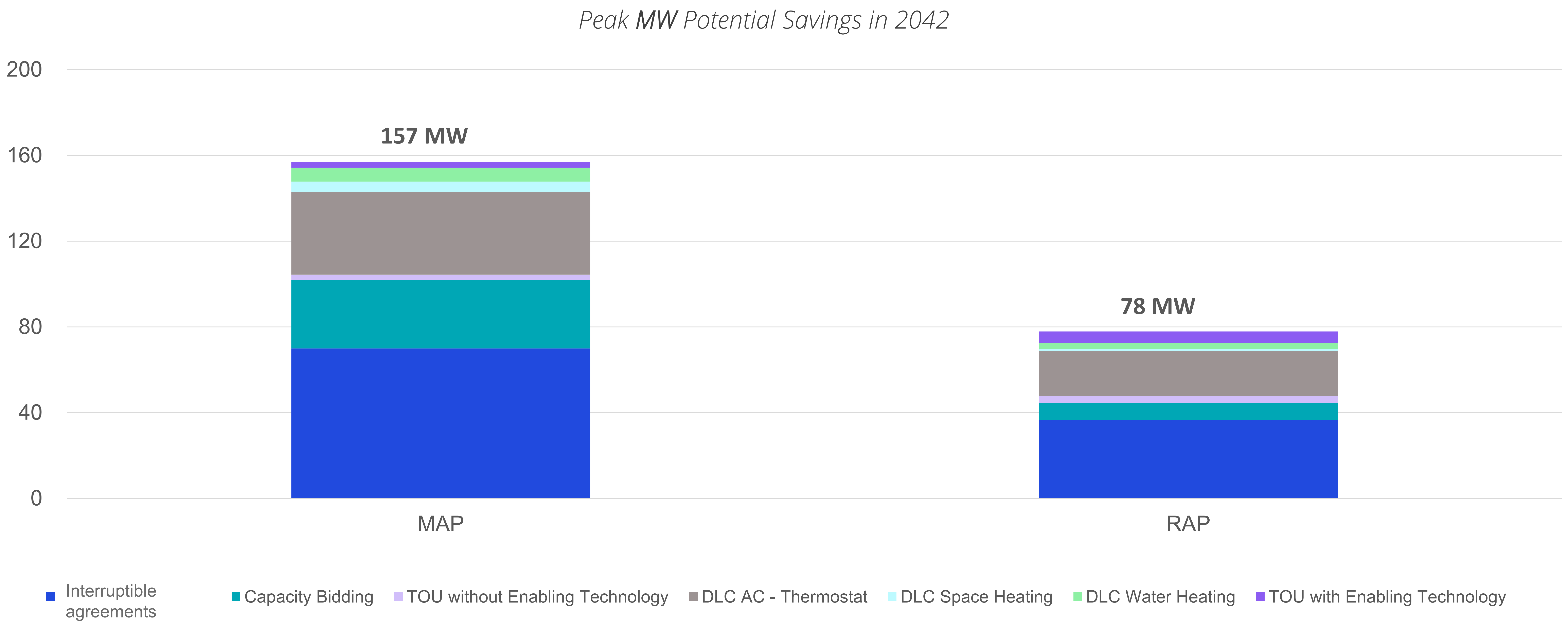
- →Direct Load Control ("DLC") – Central ACs
- →DLC – Room ACs
- →DLC – Smart Appliances
- →DLC – Water Heaters
- →DLC – Electric Space Heat
- →DLC – Lighting
- →Battery Energy Storage
- →Electric Vehicle Charging
- →Interruptible Agreements
- →Demand Bidding
- →Capacity Bidding
- →Time of Use Rates
- →Behavior DR

Residential Demand Response MAP/RAP Results



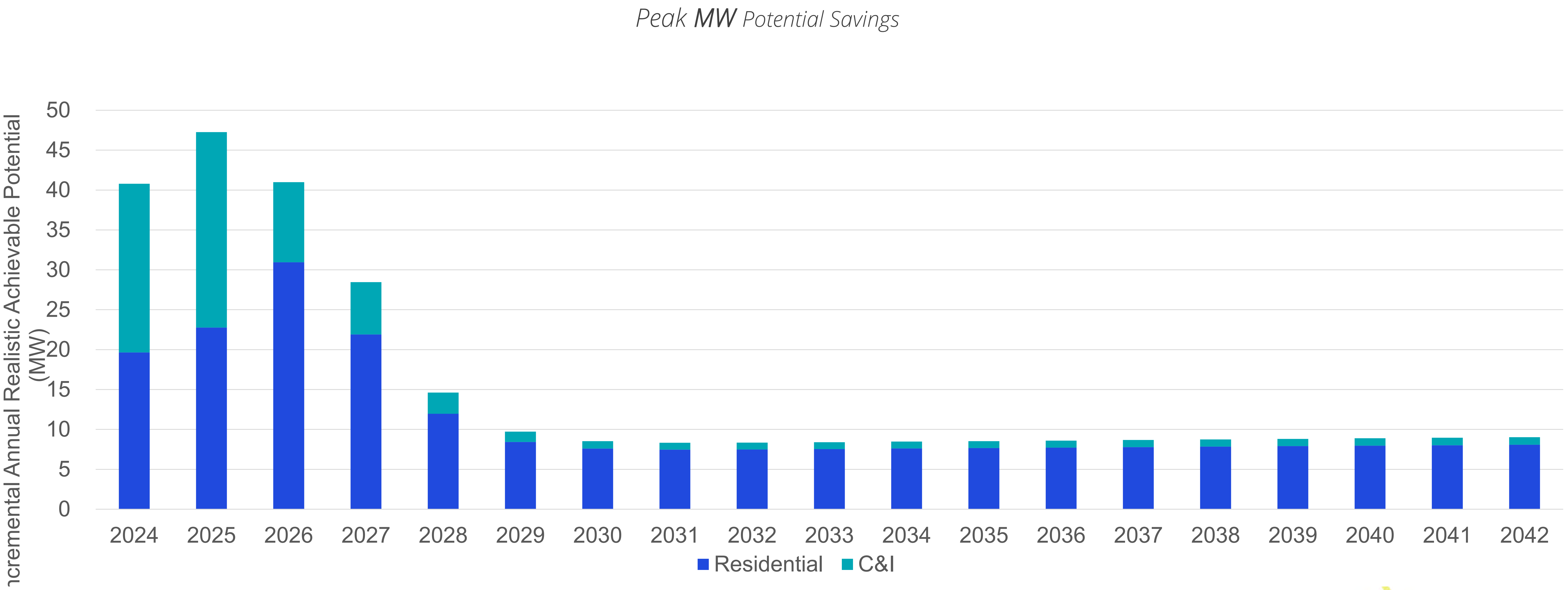
GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

C&I Demand Response MAP/RAP Results

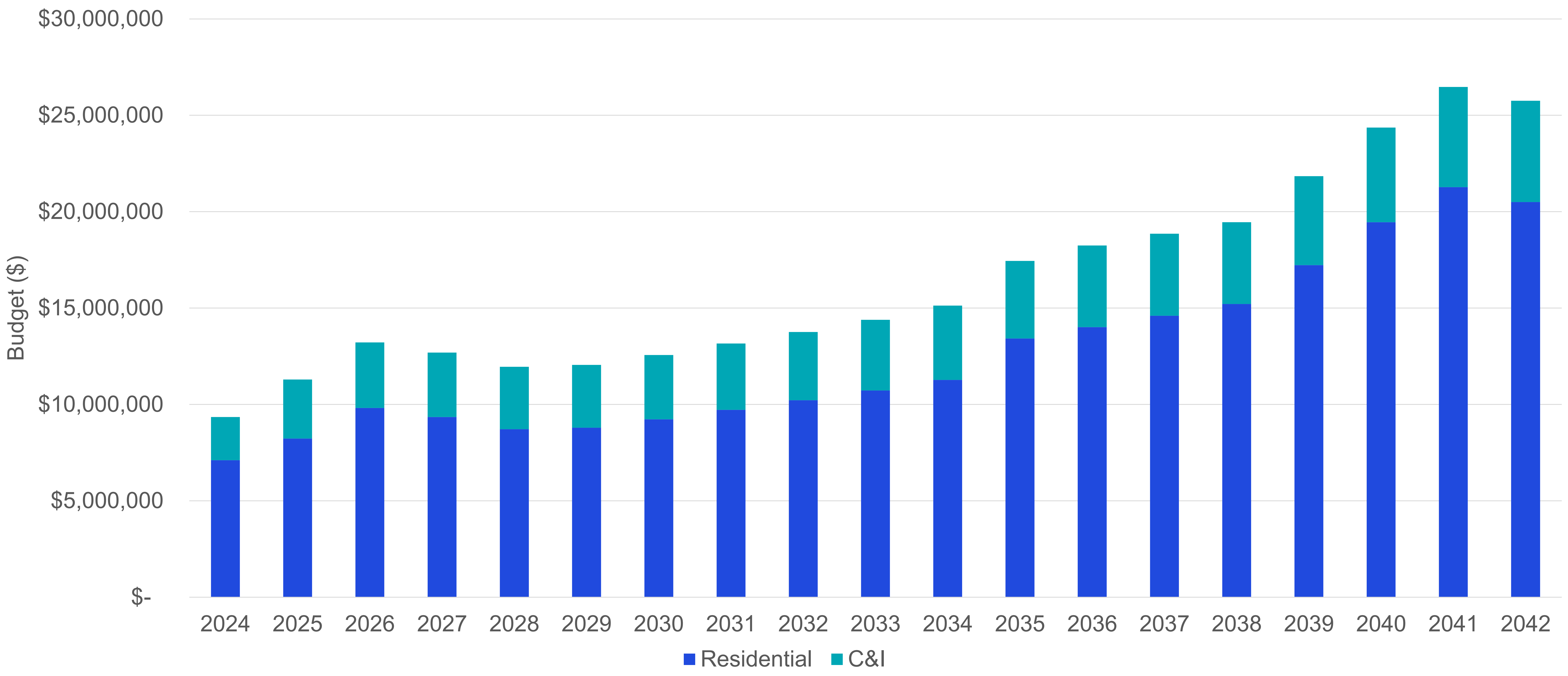


Annual Demand Response (RAP – by Sector)

INCREMENTAL ANNUAL



Annual Demand Response Budgets (by Sector)



DSM Market Potential Study

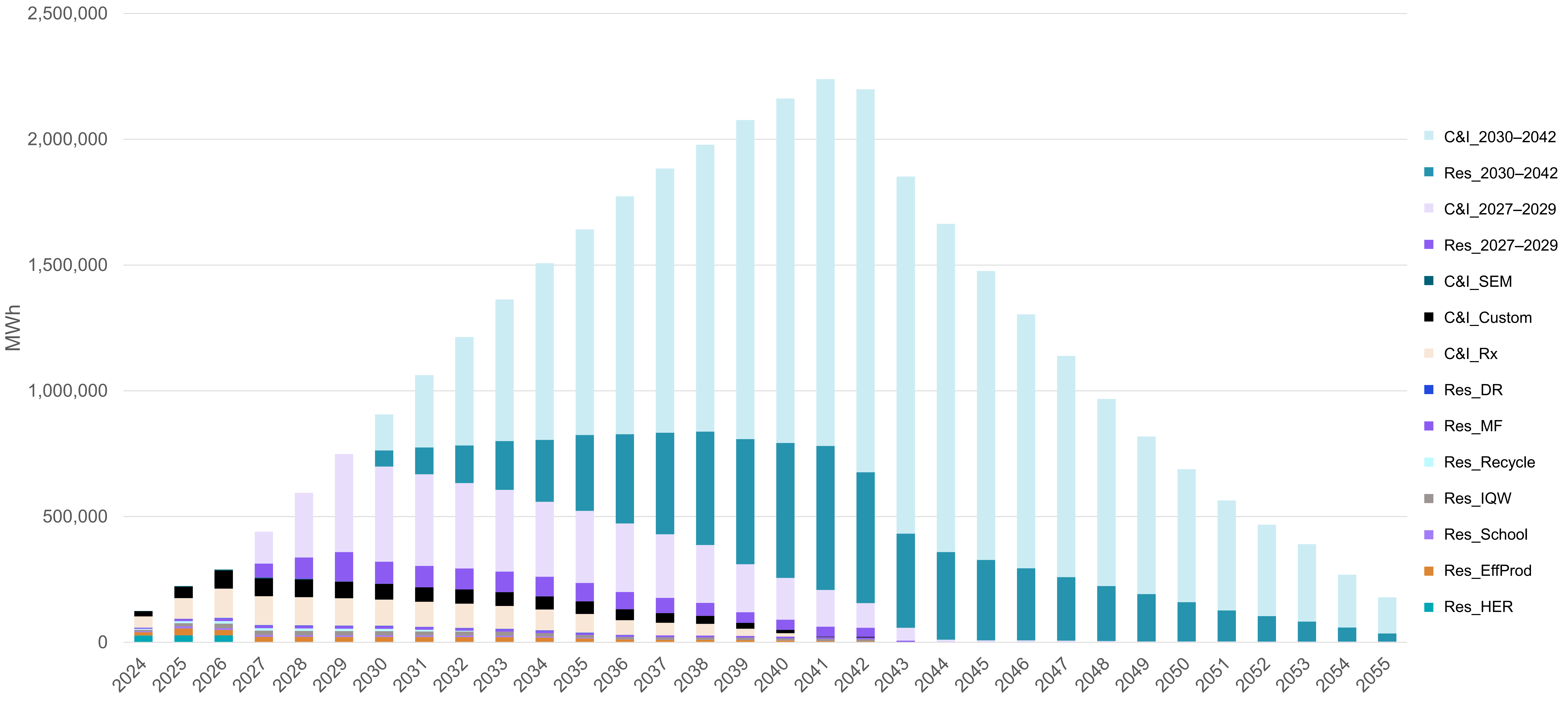
Developing DSM IRP Inputs

IRP Inputs – Energy Efficiency

Reference Case

- → EE Inputs for reference case will align with the Program RAP Potential
- → EE Inputs will be provided over three different vintages
  - 2024-2026 (3 years)
  - 2026-2028 (3 years)
  - 2029-2042 (13 years)
- → For 2024-2026 Vintage, EE Inputs will be bundled to closely resemble program offerings
  - For remaining vintages, EE Inputs will be aggregated at the sector level
- → EE Costs will include utility costs (incentives and non-incentive costs) and will be adjusted to reflect the NPV impacts of T&D benefits.
- → *2023 will be "hard coded" to align with current approved DSM Plan savings and costs*

IRP Inputs – Energy Efficiency



IRP Inputs – Energy Efficiency

Time Differentiated Savings

→Within a bundle/vintage, the EE Savings are broken out by end-use

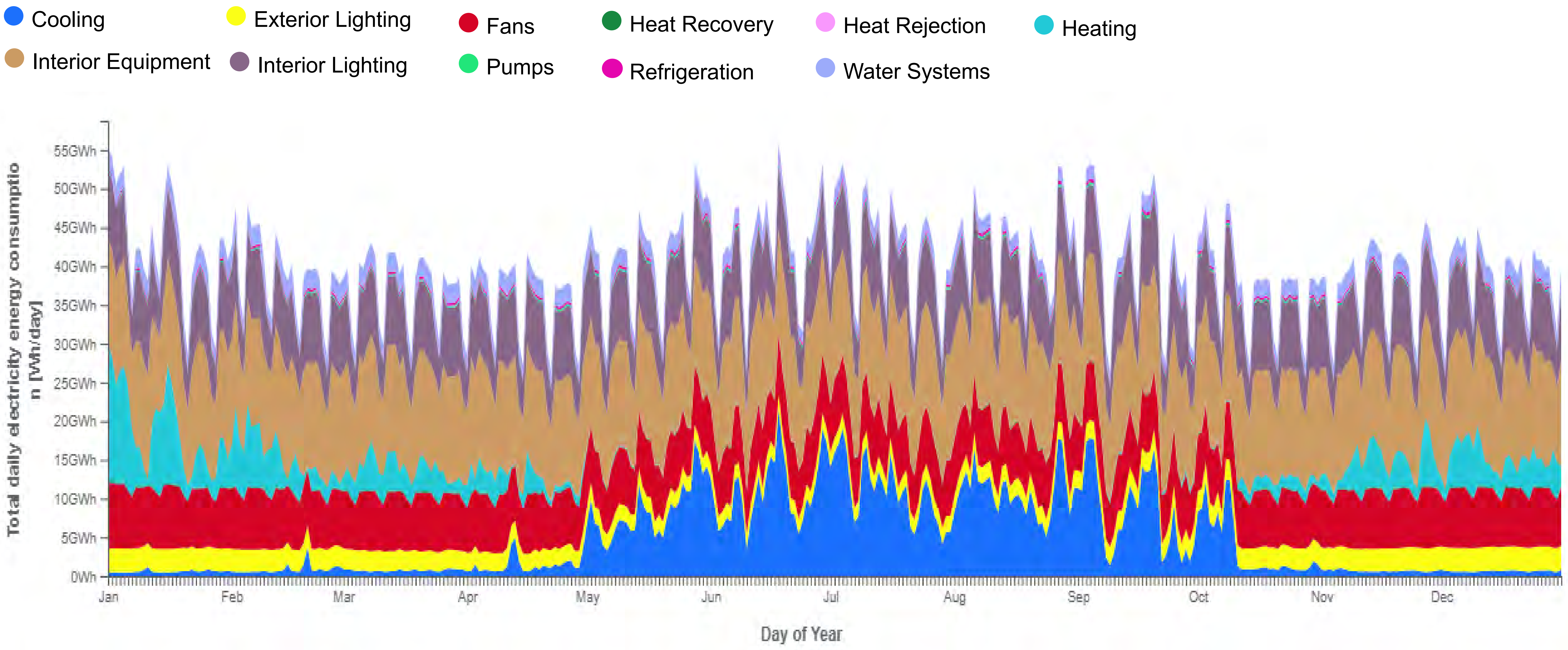
→Saving by end-use are mapped to 8,760 end-use load shape data, developed by National Renewable Energy Laboratory (NREL) and Lawrence Berkeley National Lab (LBL).

- Residential sector includes 33 end-uses
- Nonresidential sector includes 11 end-uses

→Hourly savings shapes are provided so that the model captures the timing of savings relative to the AES Indiana system and peak periods.

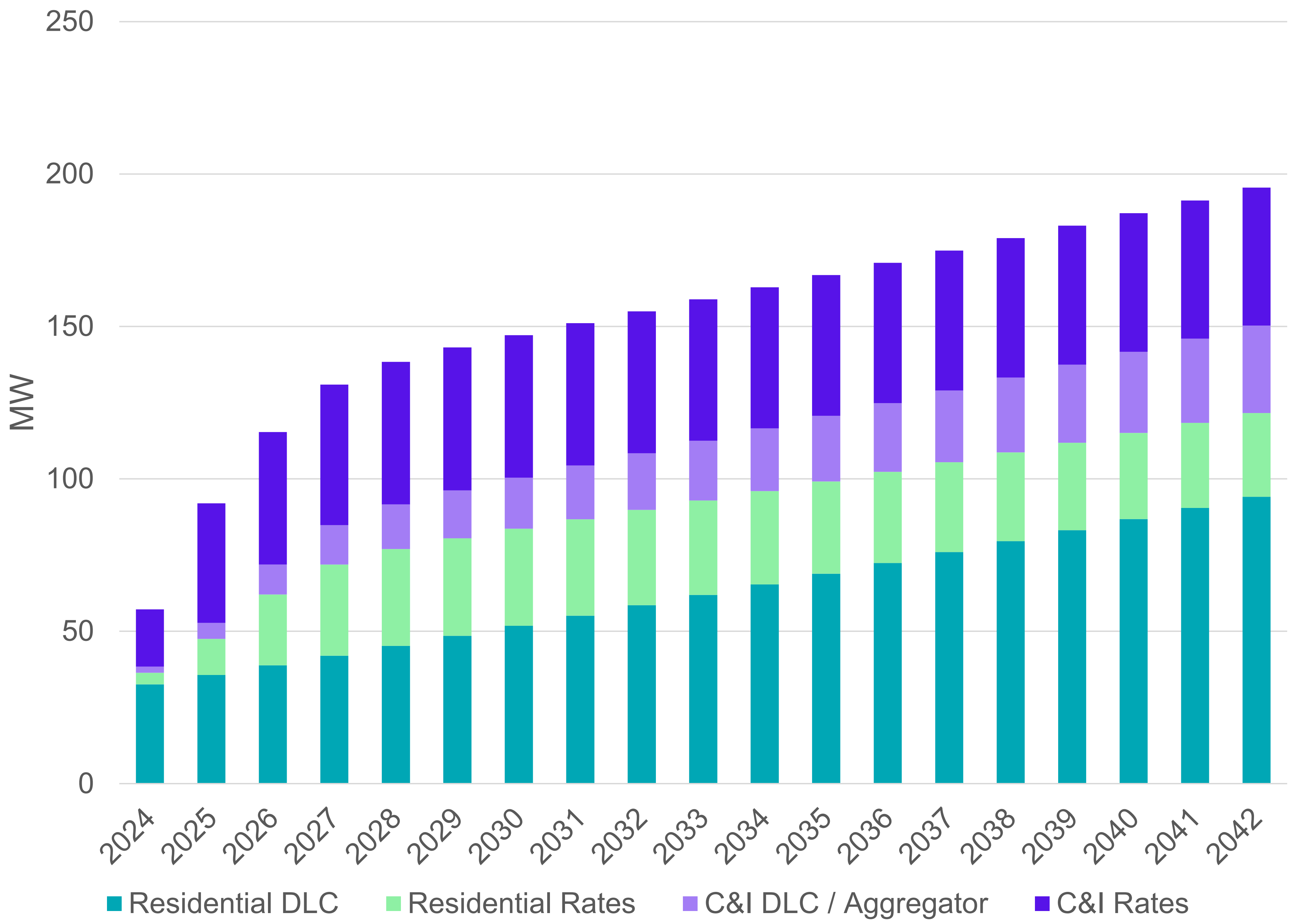
IRP Inputs – Energy Efficiency

Example Commercial Loadshape Data



IRP Inputs – Demand Response

- Bundles for demand response follow the same vintages as Energy Efficiency
- Demand response bundles created for four categories
  - Residential DLC
  - Residential Rates
  - C&I DLC/Aggregator
  - C&I Rates
- DR bundles will include savings for both summer and winter peak, with summer peak savings potentially generally more significant



GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

Break for Lunch

Current Generation Portfolio Overview

Kristina Lund, President & CEO, AES Indiana

aes Indiana

Current Portfolio

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

aes Indiana

Capabilities and Infrastructure

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.

Replacement Resource Assumptions

Erik Miller, Manager, Resource Planning, AES Indiana

Commercially Available Replacement Resources

DSM/EE

- EE & DR Measures bundled into traunches for planning model selection

Wind

- Land-Based Wind

Solar

- Utility-Scale
- C&I
- Residential

Storage

- Utility-Scale standalone
- Solar + Storage

Natural Gas

- CCGT
- CT
- Reciprocating Engine/ICE
- Pete Refuel

aes Indiana

Key Replacement Resource Assumptions for IRP Modeling

Replacement Resource Assumptions are the key inputs that the planning model uses for selecting replacement resources when energy or capacity is needed.

Replacement Resource Assumptions include:

- → Overnight Capital Cost to construct ($/kW) – Costs associated with development and construction of resource
- → Operating Cost:
  - Fixed Operation & Maintenance (FOM) – Costs incurred whether plant is operating or not, e.g. staff cost, regular maintenance, administrative costs
  - Variable Operation & Maintenance (VOM) – Costs associated with electricity production, e.g. repair and replacement of parts
- → Operating Characteristics:

Operating Characteristics		
Solar & Wind	**Storage**	**CT or CCGT (Natural Gas)**
Generation Profiles	Ramp Rates	Heat Rates
Effective Load Carrying Capability (ELCC)	Capacity Accreditation	Ramp Rates
MW Limits	MW and MWh Limits	Capacity Accreditation
Asset Useful Life	Asset Useful Life	MW Limits
		Asset Useful Life

aes Indiana

Methodology for Replacement Resource Cost Assumptions

Overview

- AES Indiana used a combination of Sargent & Lundy's (S&L) RFP review, Bloomberg New Energy Finance (BNEF), National Renewable Energy Labs (NREL) and Wood Mackenzie data to benchmark the starting year assumptions for replacement resources in this IRP.
- Replacement Resource capital cost forecasts were calculated by averaging forecasts from NREL, BNEF and Wood Mackenzie or from S&L.

Sargent & Lundy's (S&L) review of AES Indiana's 2019 RFP

- AES Indiana contracted S&L to administer the Company's 2019 All-source RFP for generation.
- As follow up to this work, S&L summarized the cost and operating components for the resources included in the 2019 All-source RFP to inform the 2022 IRP.
- To supplement this review, S&L also reviewed and sourced their internal databases and a comprehensive list of public data sources.
- Resources reviewed:
  - Solar
  - Wind
  - Solar + Storage
  - Standalone 4-hr Storage
  - Combustion Turbine (Frame and Aeroderivative)
  - Combined Cycle Gas Turbine
  - Reciprocating Engine
- Cost components reviewed:
  - Capital Cost ($/kWac)
  - Interconnection Cost ($/kWac)
  - Cost of Tax Equity ($/kWac)
  - FOM ($/kWac)
  - VOM ($/MWh)
  - Capacity Factor (%)
  - Curtailment (%)
  - Property Tax ($/kWac)
  - Max Capacity per year (MW)

2022 All-Source Generation RFP

AES Indiana is conducting an all-source RFP

- Positions AES Indiana to efficiently procure generation consistent with final IRP Preferred Resource Portfolio
- Informs IRP process in considering Replacement Resource Costs sensitivities
- RFP offers requested for Commercial Operation Date (COD) of 2025-2027
- Incorporate invitation for projects leveraging remaining uncommitted Petersburg Unit 2 injection rights
- Issue RFP mid-April

Department of Commerce Anti-Dumping/Countervailing Duties (AD/CVD) investigation

- Preliminary decision 150 days
- Repercussions for solar industry
- Creates uncertainty for developers – particularly in near-term
- Issue resolution for 2025-2027 COD projects – address uncertainty around solar in RFP

Sources for Replacement Resource Cost Assumptions

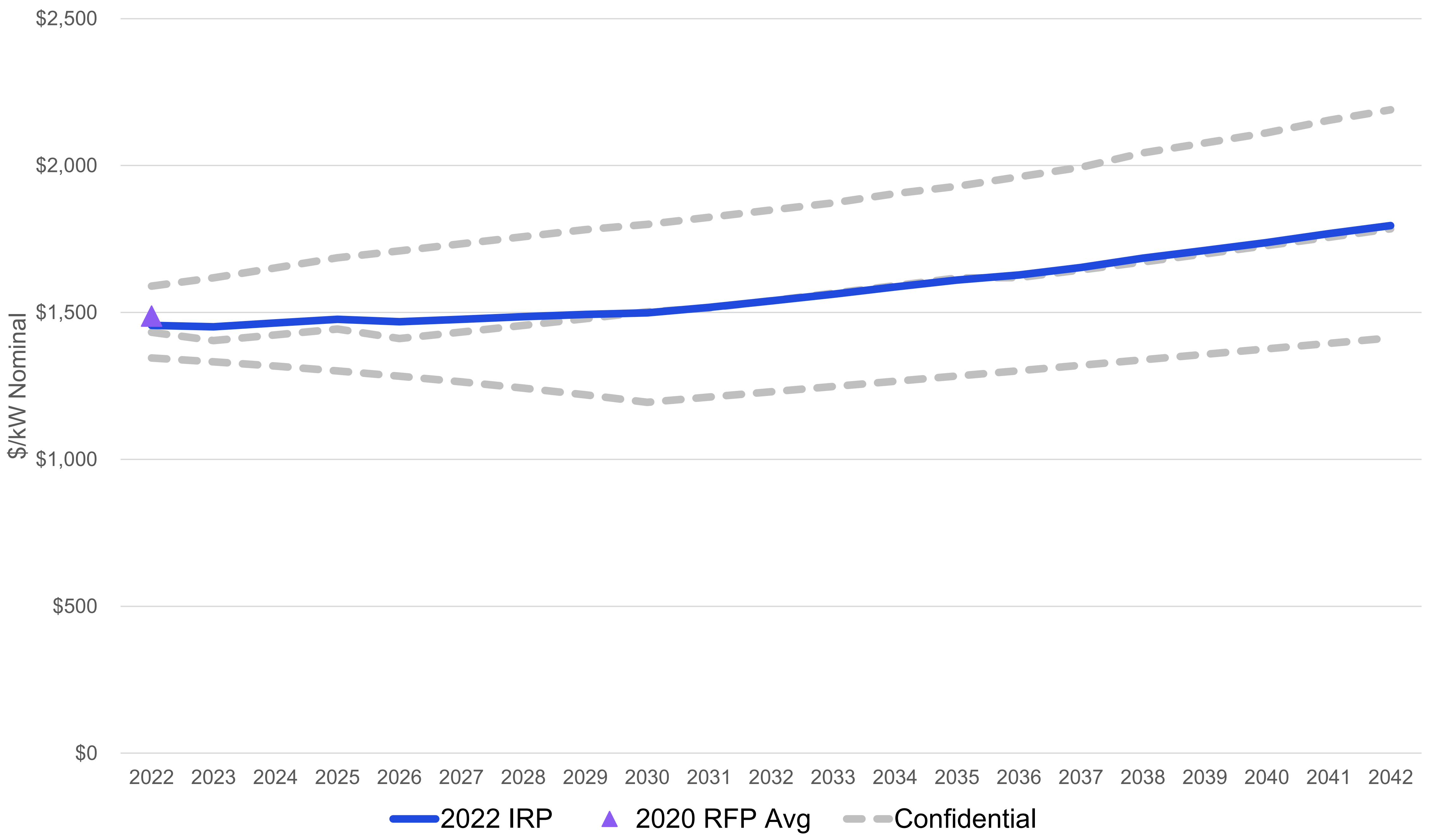
Primary Assumption	**Wind**	**Solar**	**Storage**	**Solar + Storage**	**CCGT**	**Frame CT**	**Aero CT**	**Reciprocating Engine**
Capital Cost	BNEF, NREL, Wood Mack & 2020 RFP	BNEF, NREL, Wood Mack & 2020 RFP	BNEF, Wood Mack & 2020 RFP	BNEF, NREL, Wood Mack & 2020 RFP	BNEF, NREL, Wood Mack & 2020 RFP	BNEF, NREL, Wood Mack & 2020 RFP	Sargent & Lundy	Sargent & Lundy
Fixed O&M	Company Assets	Company Assets	Company Assets	Company Assets	Company Assets	Company Assets	Sargent & Lundy	Sargent & Lundy
Variable O&M	N/A	N/A	N/A	N/A	Company Assets	Company Assets	Sargent & Lundy	Sargent & Lundy
Operating Characteristic	NREL System Advisory Model (SAM)	NREL System Advisory Model (SAM)	NREL 2021 ATB	NREL 2021 ATB	Company Assets	Company Assets	Sargent & Lundy	Sargent & Lundy
Other Key Assumption								
ELCC / Capacity Credit	Horizons Energy / MISO	Horizons Energy / MISO	Horizons Energy / MISO	Horizons Energy / MISO	MISO	MISO	MISO	MISO
Grid Connection Cost	Sargent & Lundy	Sargent & Lundy	Sargent & Lundy	Sargent & Lundy	Sargent & Lundy	Sargent & Lundy	Sargent & Lundy	Sargent & Lundy
Tax Equity Cost	Sargent & Lundy	Sargent & Lundy	N/A	Sargent & Lundy	N/A	N/A	N/A	N/A

aes Indiana

Wind Capital and Operating Costs

Capital Cost ($/kW)	Fixed O&M ($/kW)	Variable O&M ($/MWh)
$ 1,451	$ 30	$ -

Capital Cost Forecast

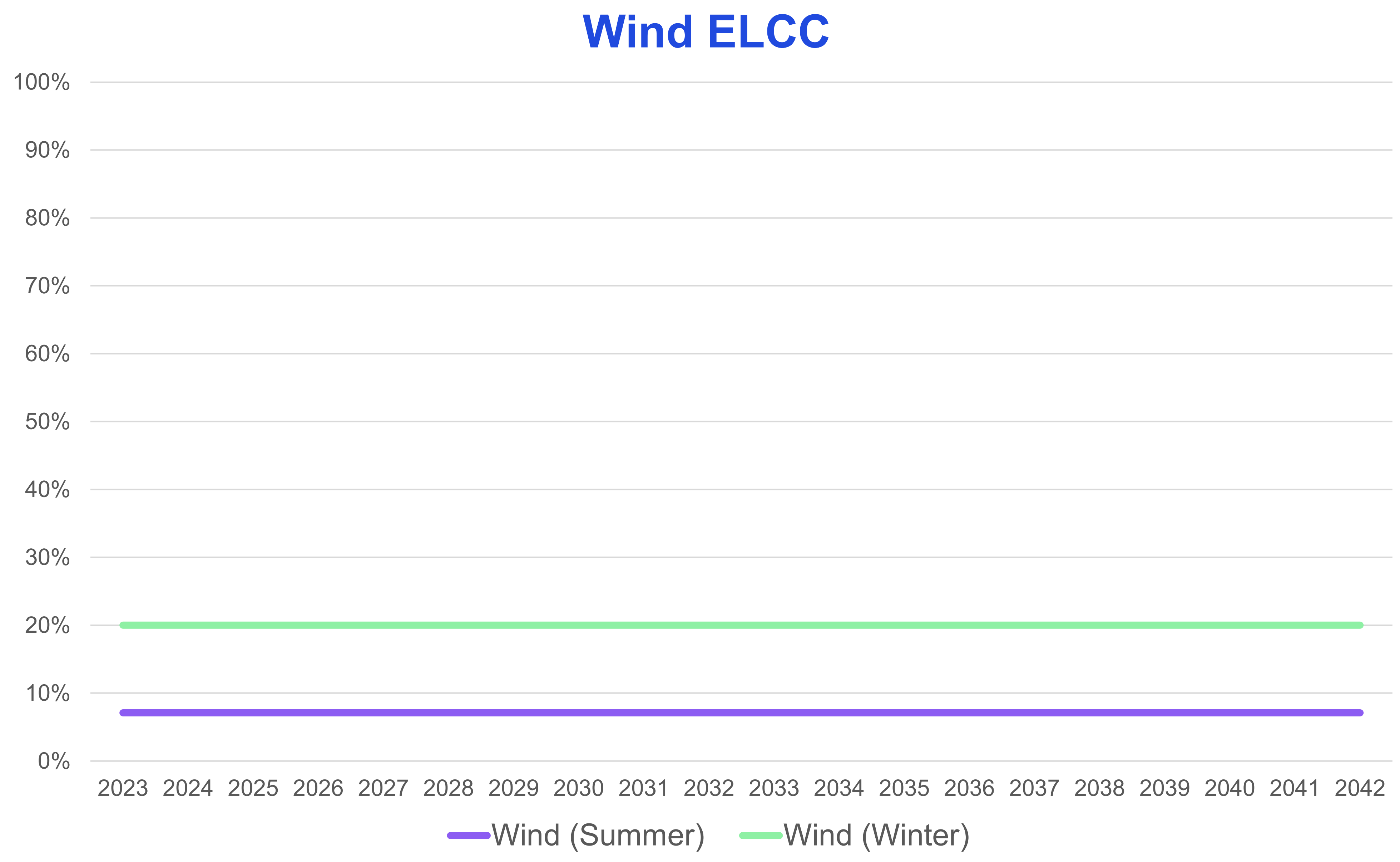


Note: Capital Cost estimates presented here are without federal tax credits. Federal tax credits will be included in modeling based on the IRP scenario assumptions.

Note: Confidential cost forecasts in chart include forecasts from NREL, Wood Mackenzie and BNEF

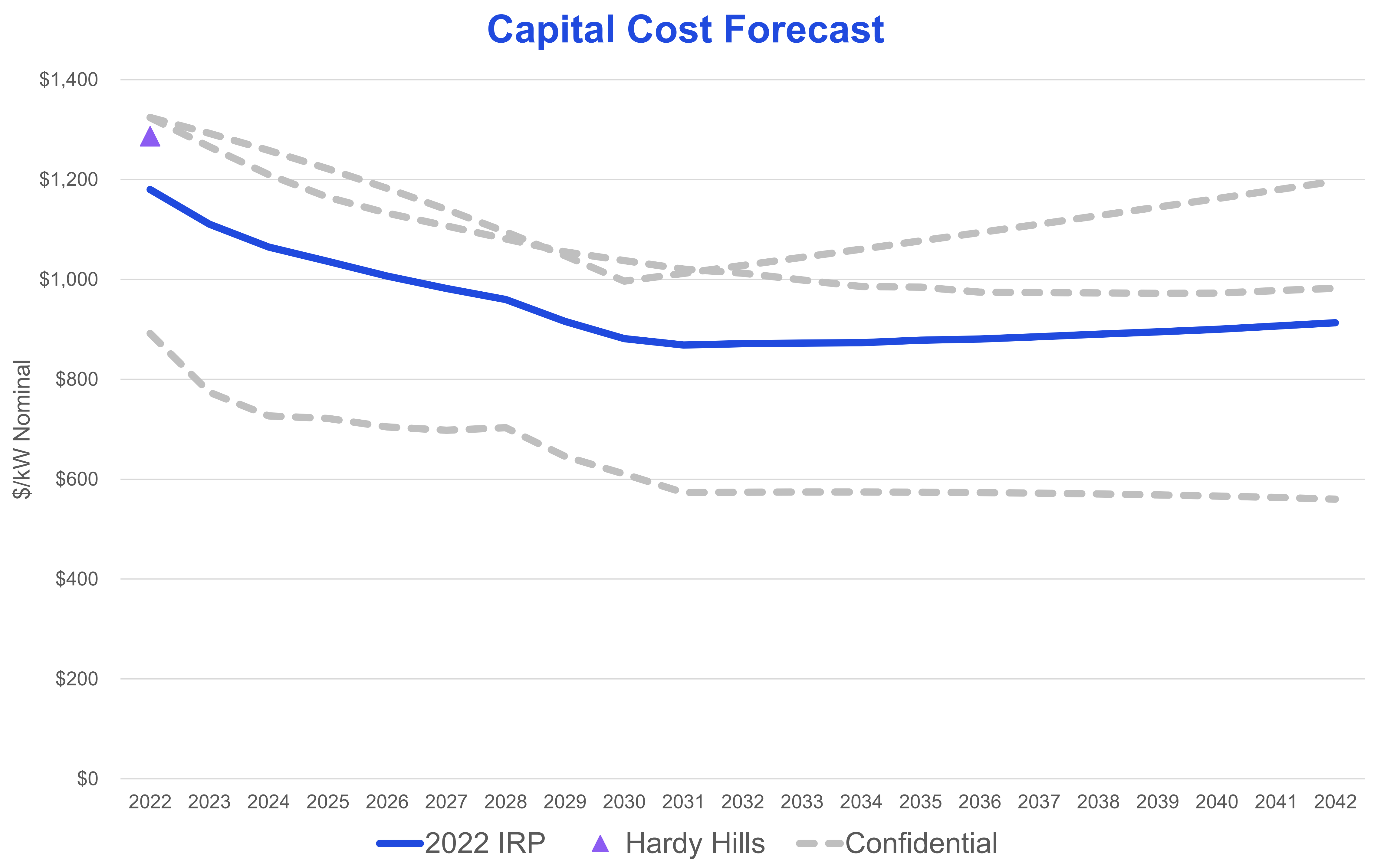
Wind Parameters

- **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*



Solar Capital and Operating Costs

Capital Cost ($/kW)	Fixed O&M ($/kW)	Variable O&M ($/MWh)
$1,111	$12	$0



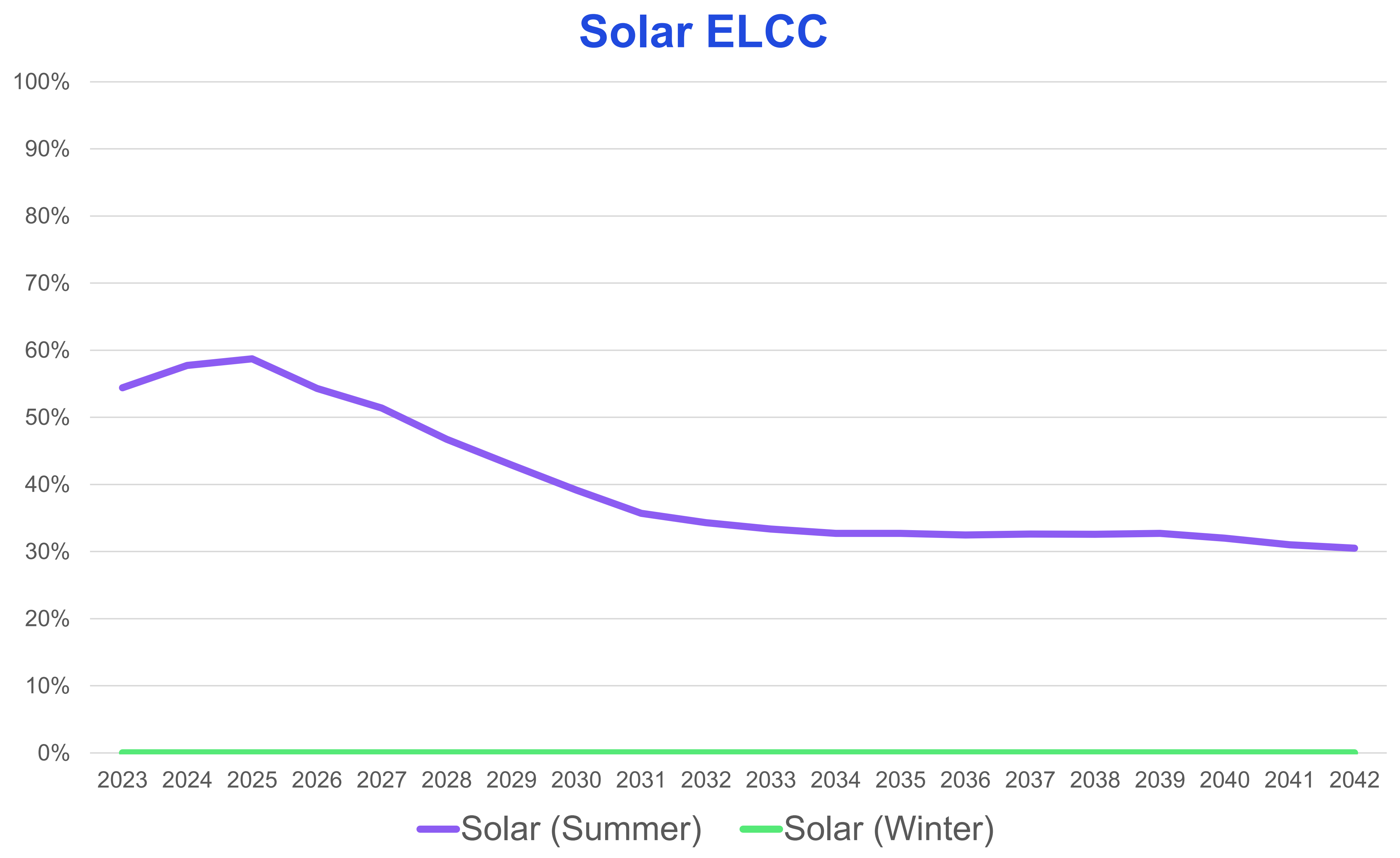
Note: Capital Cost estimates presented here are without federal tax credits. Federal tax credits will be included in modeling based on the IRP scenario assumptions.

Note: Confidential cost forecasts in chart include forecasts from NREL, Wood Mackenzie and BNEF

aes Indiana

Solar Parameters

- **Location:** Petersburg, Indiana
- **Annual Capacity Factor:** 24.5%
- **Source Profile:** NREL System Advisory Model (SAM)
- **Project Size:** 25 MW ICAP
- **Useful Life:** 35 years
- **Summer ELCC (2025):** 58.7%; *Source: Horizon Energy*
- **Winter ELCC:** 0%; *Source: MISO RAN*

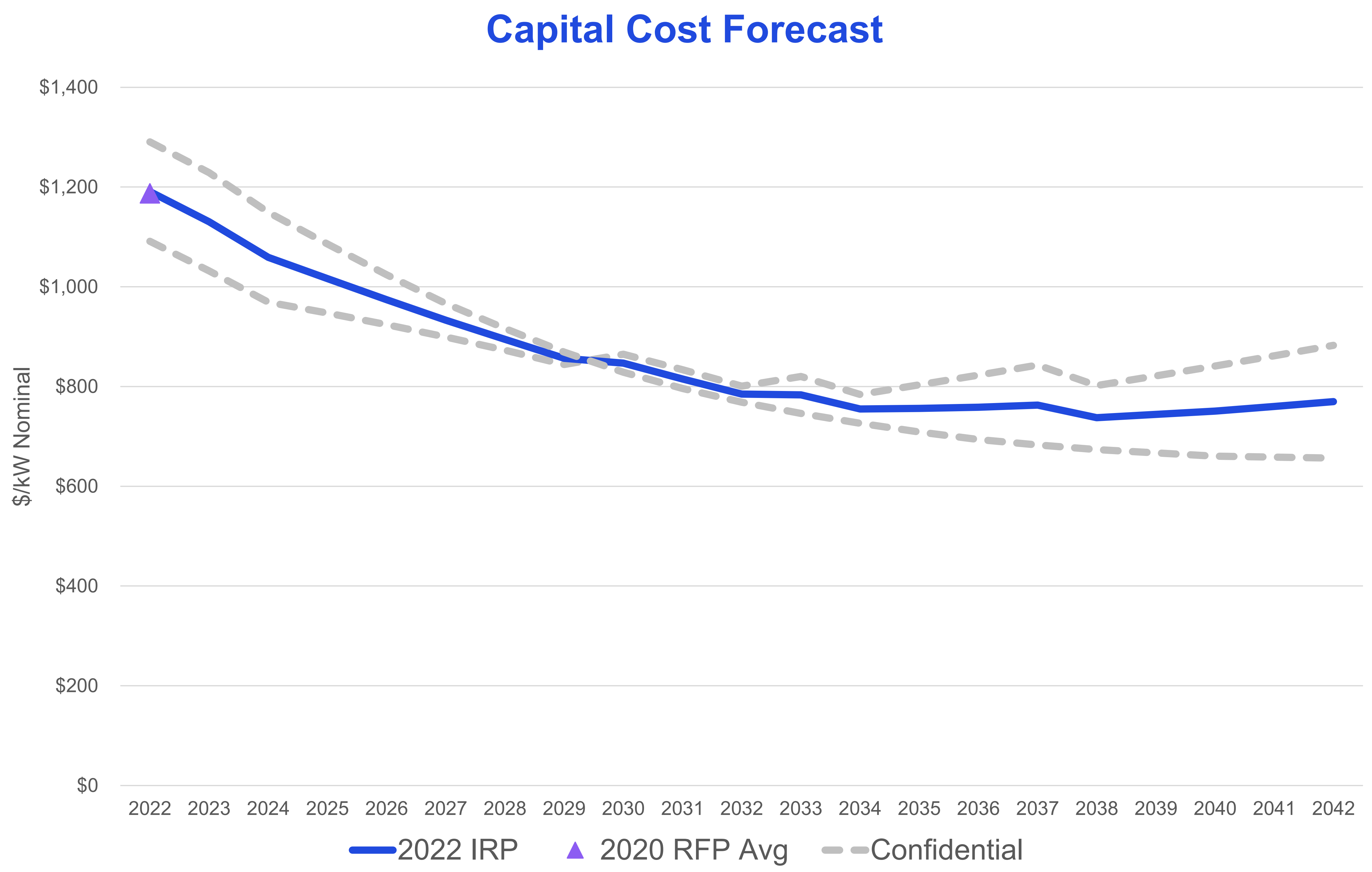


*Summer ELCC forecast presented in chart is from the Horizon Custom Reference Case – ELCC forecast will vary by custom scenario

aes Indiana

Storage Capital and Operating Costs

Capital Cost ($/kW)	Fixed O&M ($/kW)	Variable O&M ($/MWh)
$ 1,130	$ 27	$ -

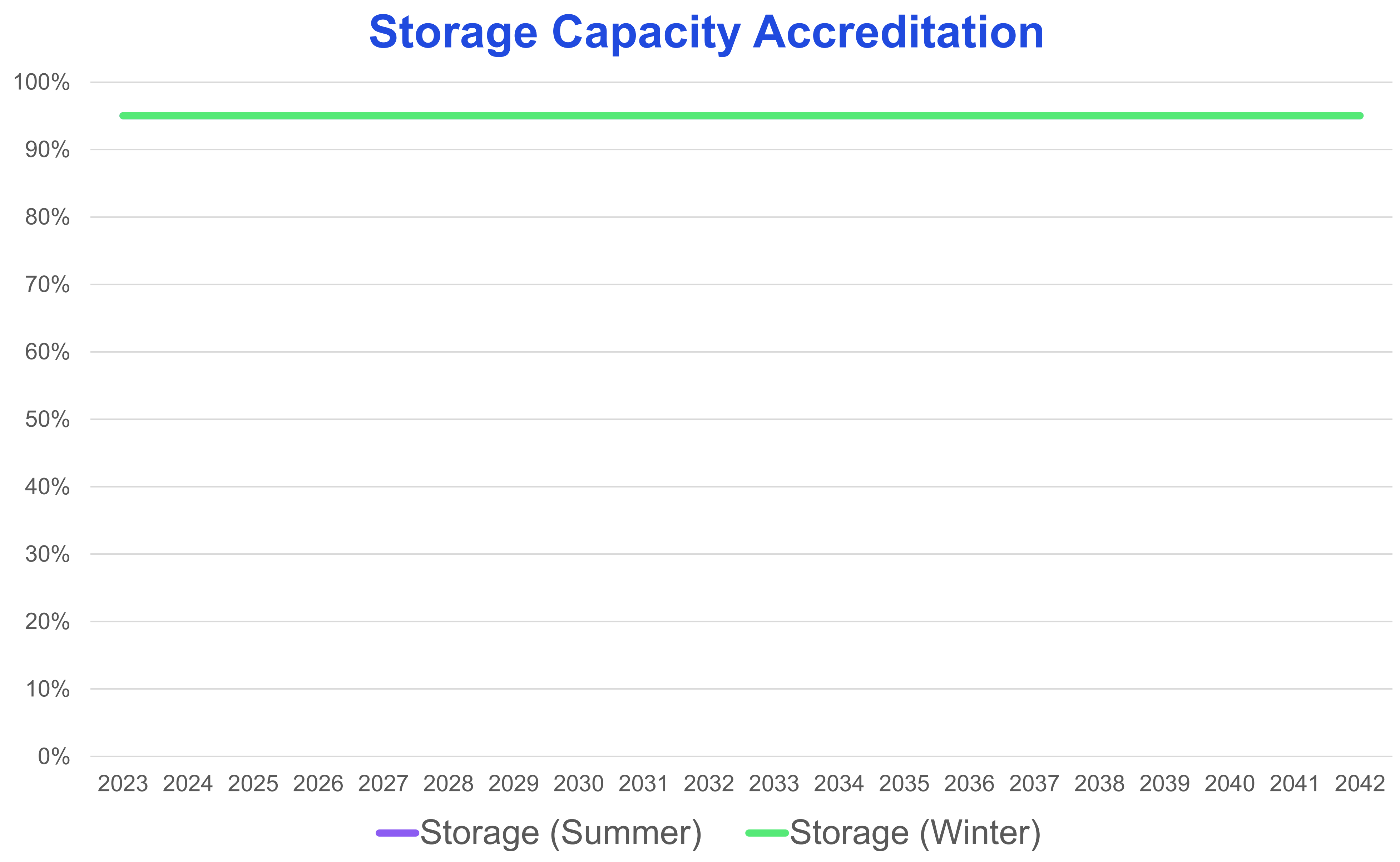


Note: Capital Cost estimates presented here are without federal tax credits. Federal tax credits will be included in modeling based on the IRP scenario assumptions.

Note: Confidential cost forecasts in chart include forecasts from Wood Mackenzie and BNEF

Storage Parameters

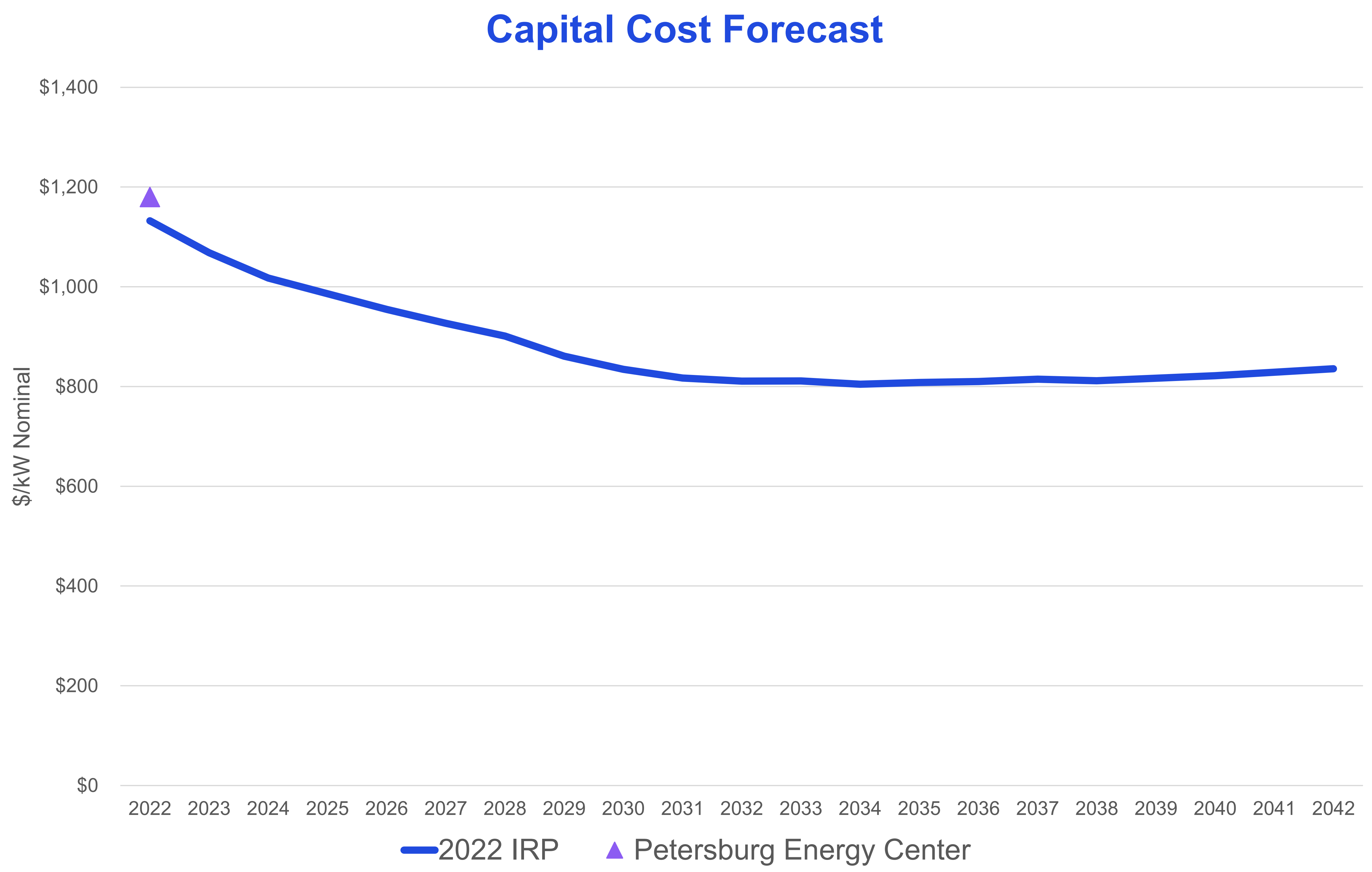
- **Location:** Indianapolis, Indiana
- **Project Size:** 20 MW ICAP | 80 MWh (4-hour)
- **Round Trip Efficiency (RTE):** 85%
- **Useful Life:** 20 years
- **Summer/Winter Capacity Accreditation:** 95% (19 MW)



Note: 6-hour Storage also be modeled and scaled off of the 4-hour Storage assumptions

Solar + Storage Capital and Operating Costs

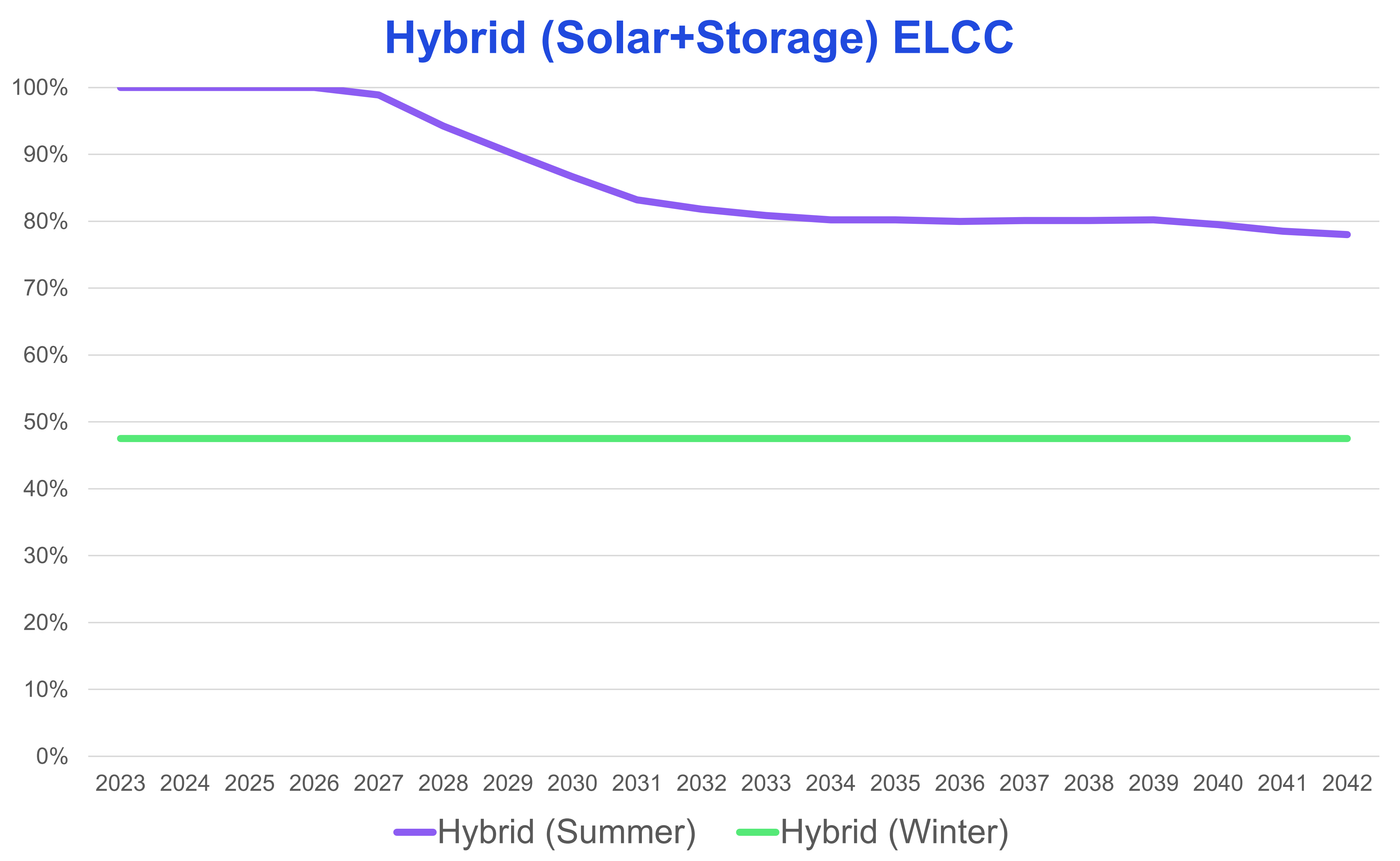
Capital Cost ($/kW)	Fixed O&M ($/kW)	Variable O&M ($/MWh)
$1,069	$17	$0



Note: Capital Cost estimates presented here are without federal tax credits. Federal tax credits will be included in modeling based on the IRP scenario assumptions.

Solar + Storage Parameters

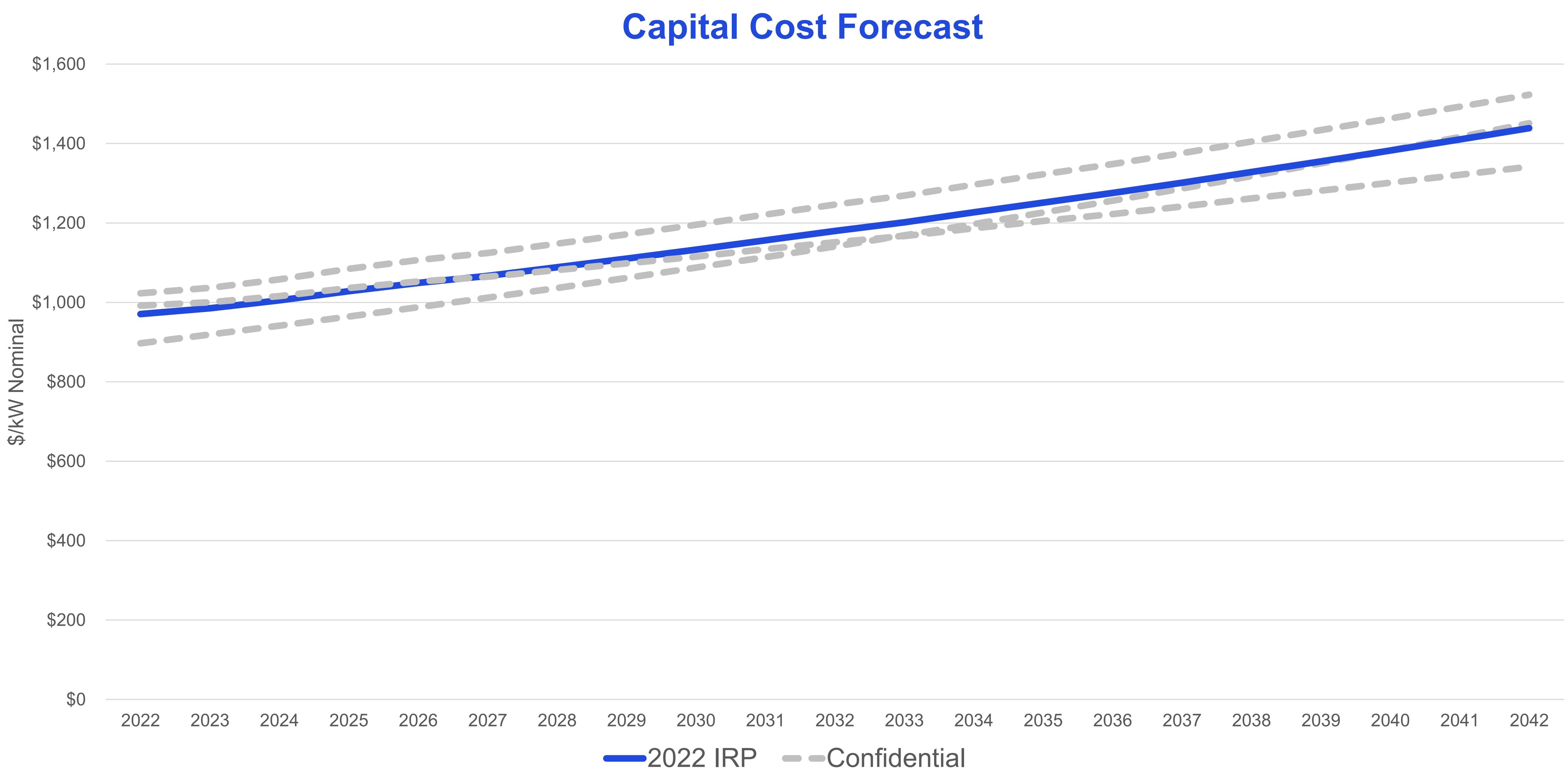
- **Location:** Petersburg, Indiana
- **System:** DC Coupled Solar + Storage System, Storage charges exclusively from the solar array
- **Solar Component:** Identical to stand-alone solar (25 MW ICAP)
- **Storage Component:** 12.5 MW ICAP | 50 MWh
- **Synergies:** 4.3% reduction in capital costs, 2%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



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

CCGT Capital and Operating Costs

Capital Cost ($/kW)	Fixed O&M ($/kW)	Variable O&M ($/MWh)
$1,026	$32	$2



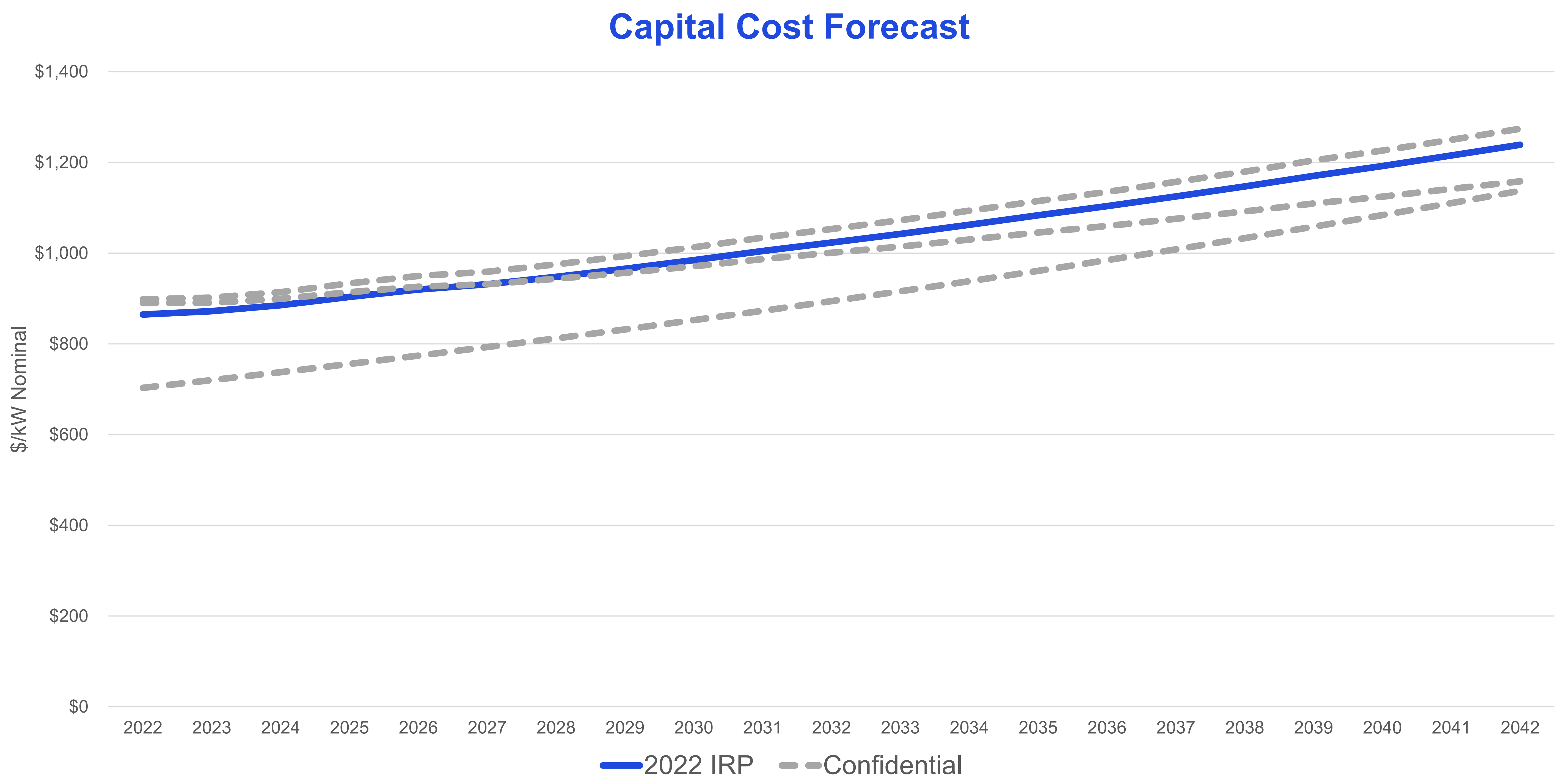
Note: Confidential cost forecasts in chart include forecasts from NREL, Wood Mackenzie and BNEF

CCGT Parameters

- **Project Size:** 325 MW ICAP
- **Heat Rate at Max Economic Load:** 6,700 Btu/kWh
- **Useful Life:** 30 years
- **Summer/Winter Capacity Credit:** 94.2% static

Frame Combustion Turbine Capital and Operating Costs

Capital Cost ($/kW)	Fixed O&M ($/kW)	Variable O&M ($/MWh)
$872	$30	$1



Note: Confidential cost forecasts in chart include forecasts from NREL, Wood Mackenzie and BNEF

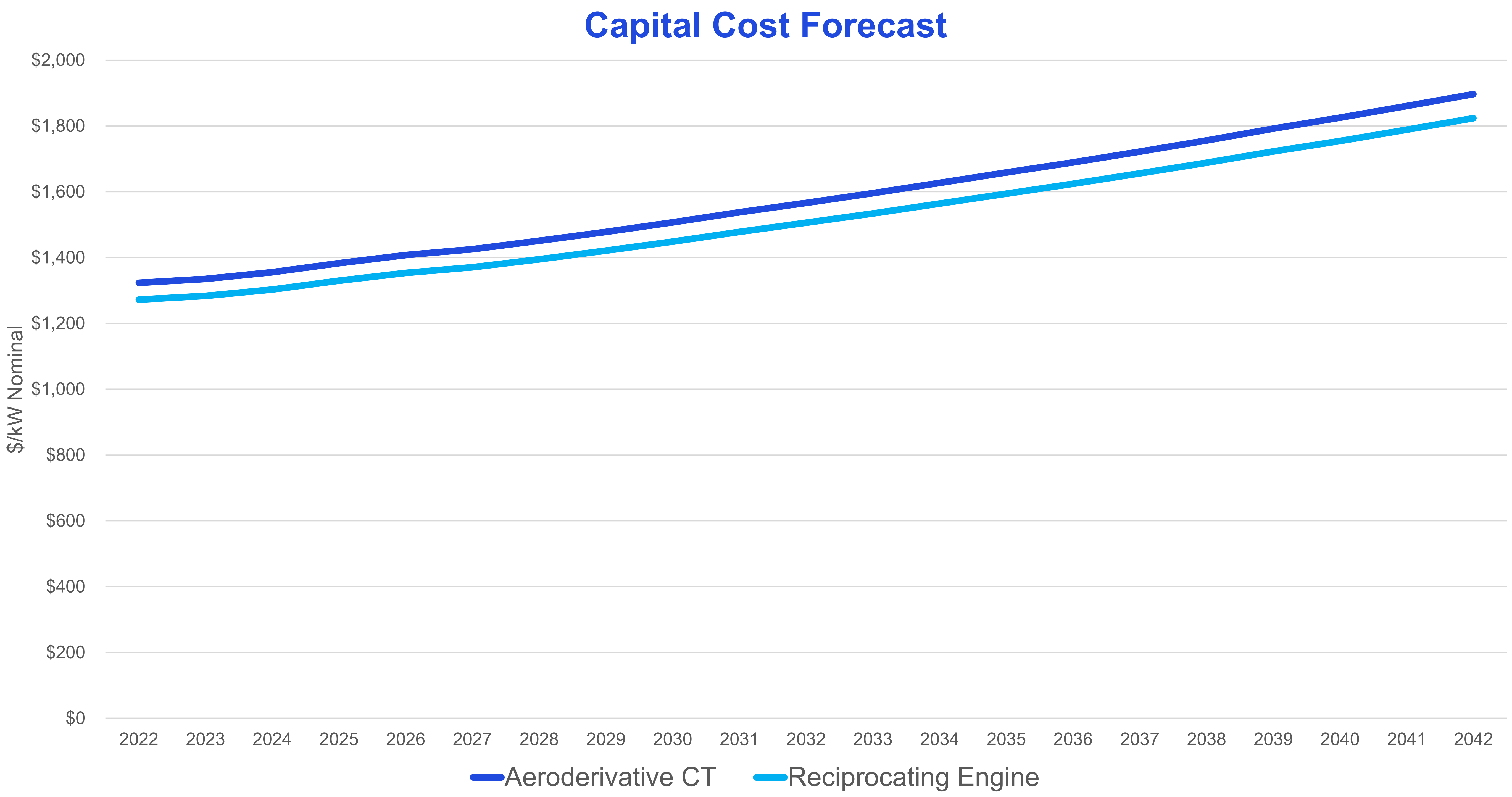
AES Indiana

Frame Combustion Turbine Parameters

- **Project Size:** 100 MW ICAP
- **Heat Rate at Max Economic Load:** 10,000 Btu/kWh
- **Useful Life:** 20 years
- **Summer/Winter Capacity Credit:** 95.6% static

Aero CT and Recip Engine Capital and Operating Costs

	Capital Cost ($/kW)	Fixed O&M ($/kW)	Variable O&M ($/MWh)
Aero CT	$1,335	$36	$5
Recip	$1,283	$46	$6



AES Indiana

Aero CT and Reciprocating Engine Parameters

Aero Combustion Turbine

- **Project Size:** 90 MW ICAP
- **Heat Rate at Max Economic Load:** 8,200 Btu/kWh
- **Useful Life:** 20 years
- **Summer/Winter Capacity Credit:** 95.6% static

Reciprocating Engine

- **Project Size:** 54 MW ICAP
- **Heat Rate at Max Economic Load:** 7,400 Btu/kWh
- **Useful Life:** 20 years
- **Summer/Winter Capacity Credit:** 95.6% static

Petersburg Refuel Capital and Operating Costs

Petersburg Units 3 & 4 Refuel to Natural Gas

→ Low capital cost (~$100/kW)

→ Refueling will require gas infrastructure upgrade not included in capital cost above

Modeling Assumptions

Costs:

→ Capital expenditure estimated based on cost to refuel Harding Street 5, 6, 7

→ Engineering analysis performed to understand the cost for gas infrastructure upgrade

Potential Refueling Benefits

→ Reduces carbon intensity (lower capacity factor and emission rate for ST gas – similar to Harding St)

→ Dispatchable resource that positions AES Indiana well with new MISO seasonal capacity construct

Refuel of Petersburg Units 3 & 4 Parameters

→ **Petersburg Unit 3**

- **Project Size:** 526 MW ICAP
- **Heat Rate at Max Economic Load:** 10,800 Btu/kWh
- **Variable O&M:** < $0.50/MWh
- **Fixed O&M:** 65% reduction from coal Fixed O&M
- **Useful Life:** 20 years
- **Summer/Winter Capacity Credit:** 90.9% static

→ **Petersburg Unit 4**

- **Project Size:** 526 MW ICAP
- **Heat Rate at Max Economic Load:** 10,800 Btu/kWh
- **Variable O&M:** < $0.50/MWh
- **Fixed O&M:** 65% reduction from coal Fixed O&M
- **Useful Life:** 20 years
- **Summer/Winter Capacity Credit:** 94.1% static

IRP Portfolio Matrix Introduction

Erik Miller, Manager, Resource Planning, AES Indiana

Portfolio Matrix: Strategies vs. Scenarios

AES Indiana's Portfolio Matrix considers four generation portfolio Strategies across four Scenarios

Strategies

→ AES Indiana's potential future strategies for the generation portfolio.

→ Retirement dates, capital expenditures & cost treatments are anticipated and defined for each strategy and included in the planning model.

Scenarios

→ Scenarios are views of the future defined by external influences like political outcomes, economics, regulations, etc.

→ In the planning model, each scenario will have a unique set of input assumptions that correspond to the external influences defining the scenario.

***Note that AES Indiana will also use stochastics & sensitivities to assess risk around particular variables, e.g. replacement resource costs.**

aes Indiana

IRP Strategies

Generation Portfolio Strategies

No Changes to Existing Portfolio	→ Status quo → Units remain in service through useful life of 2042
Petersburg Refuel	→ Petersburg Unit 3 & 4 refueled to Natural Gas in 2025 → Natural gas pipeline already present on site
One Petersburg unit retires early (2026)	→ One unit retired early in 2026 → The other unit remains in service through useful life of 2042 → Replacement capacity starting in 2026
Both Petersburg units retire early (2026 & 2028)	→ One unit retires early in 2026 → The other unit retires early in 2028

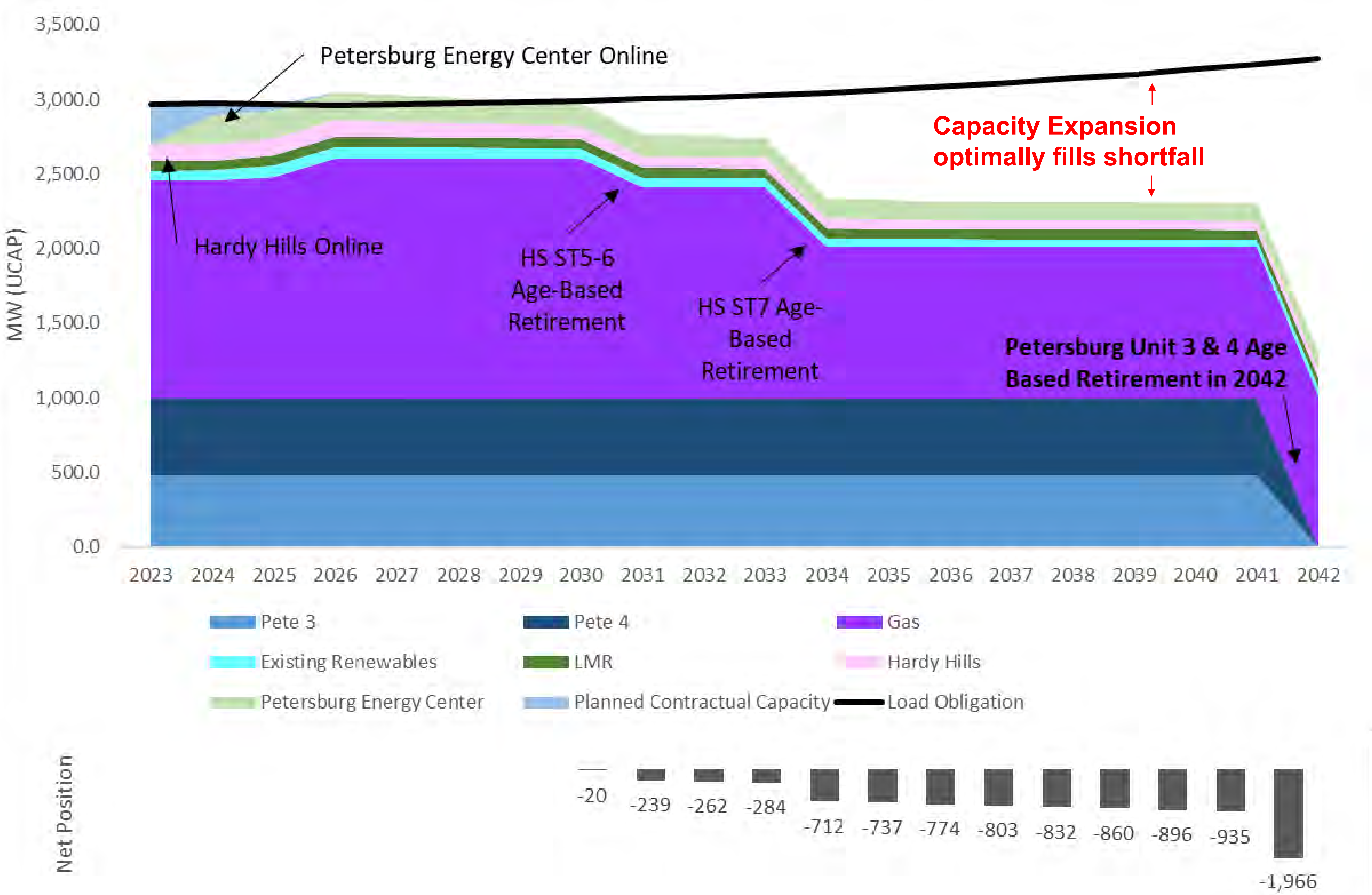
Rationale for Predefined Portfolio Strategies

Generation Portfoilo Strategy	Rationale
No Changes to Existing Portfolio	Provides portfolios with coal through 2042 for Scorecard metric comparison & evaluation
Petersburg Refuel	Earliest possible refuel date that provides sufficent lead time to execute the natural gas conversion
One Petersburg Unit Retires Early (2026)	Earliest possible retirement date that provides sufficient lead time to procure capacity
Both Petersburg Units Retire Early (2026 & 2028)	Staggering specific unit retirement dates provides sufficient lead time to procure capacity

Predefined strategies provide for comparison and evaluation of portfolios with the earliest possible exit from coal vs portfolios with coal through the entire planning period.

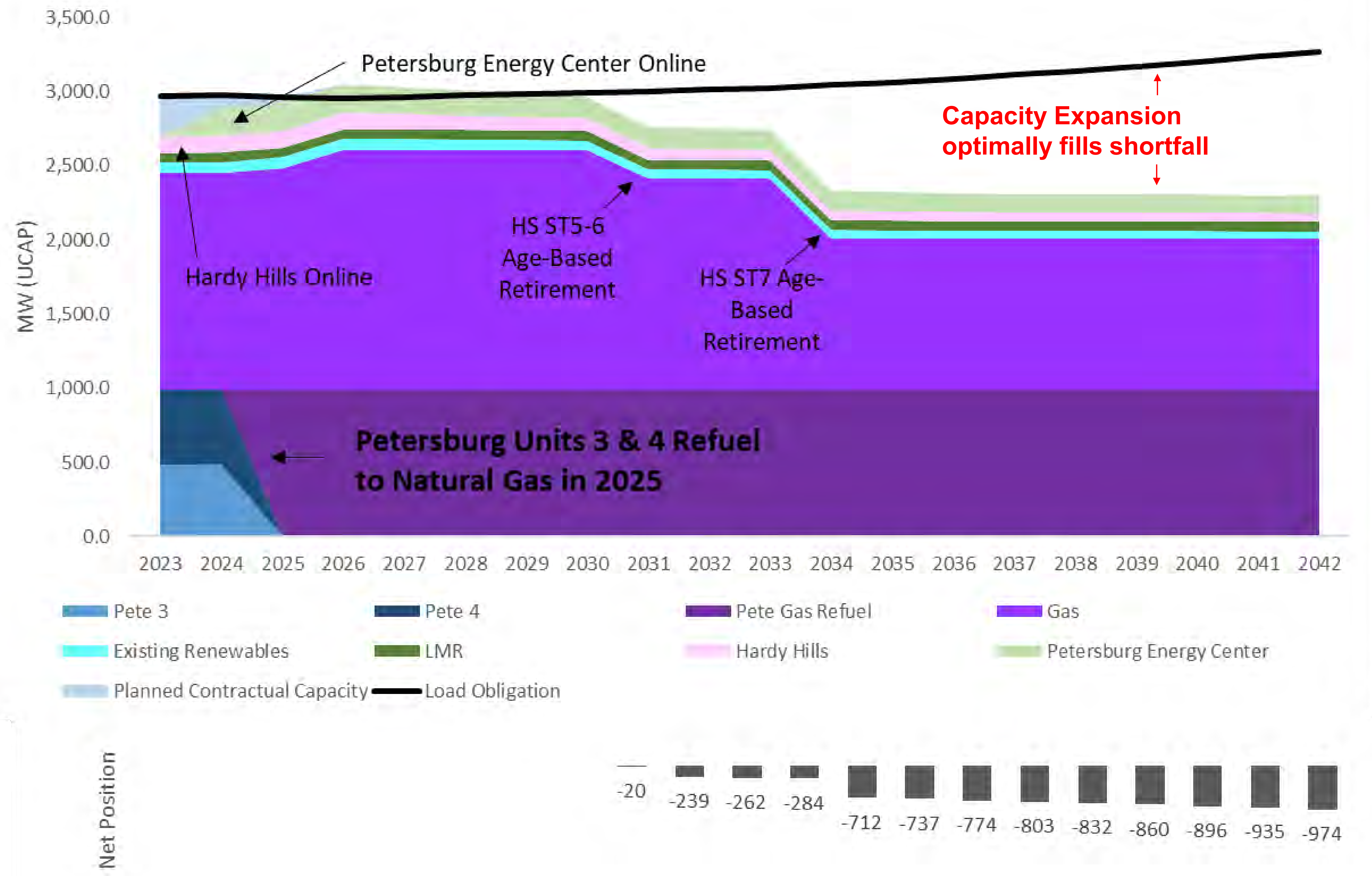
Note: To support decision making, AES Indiana will perform capacity expansion analysis without specified dates that allows the Encompass model to fully optimize retirements and replacements; however, outcomes from this analysis may not be viable and/or reasonable.

Strategy: No Changes to Existing Portfolio



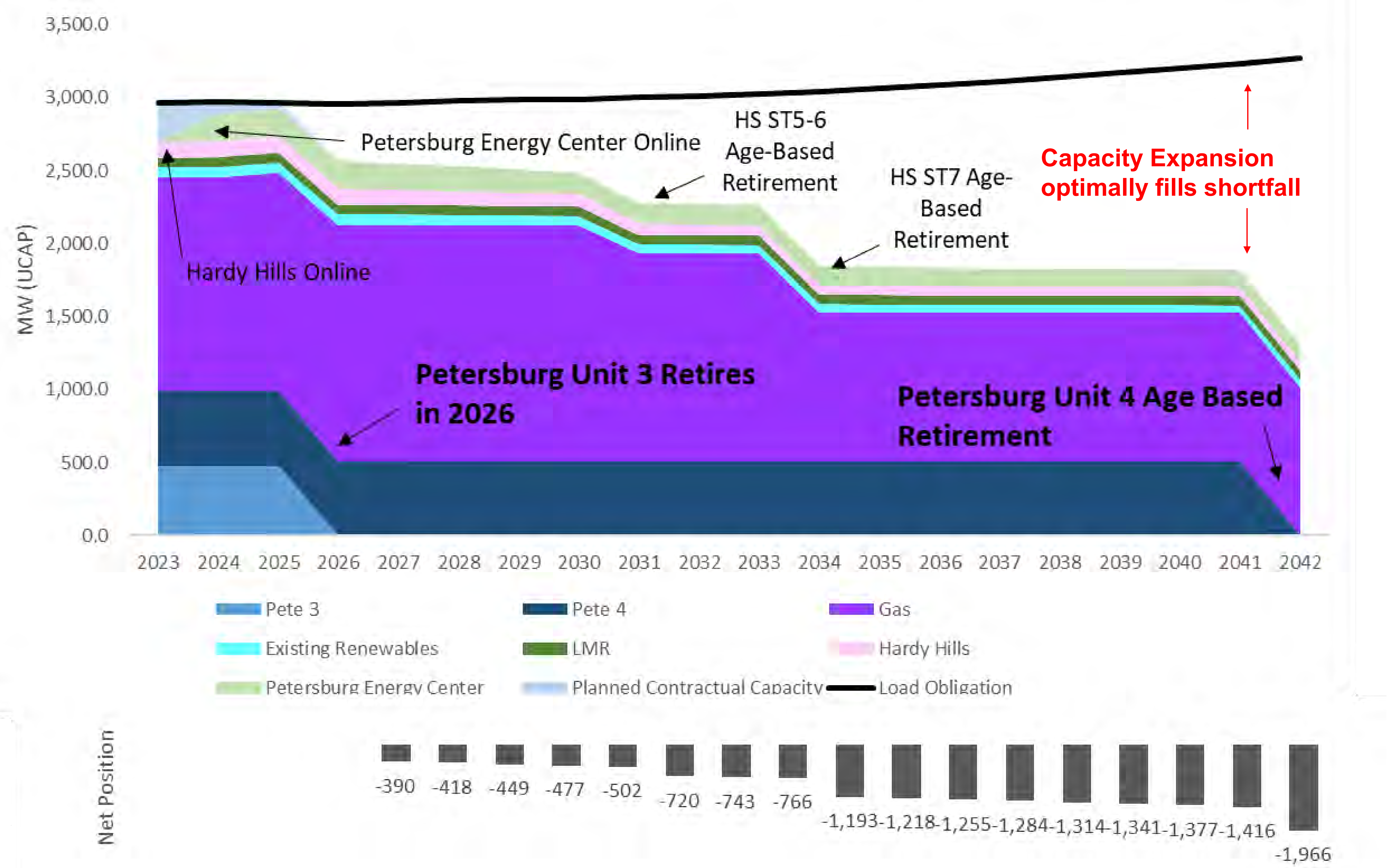
aes Indiana

Strategy: Petersburg Refuel in 2025



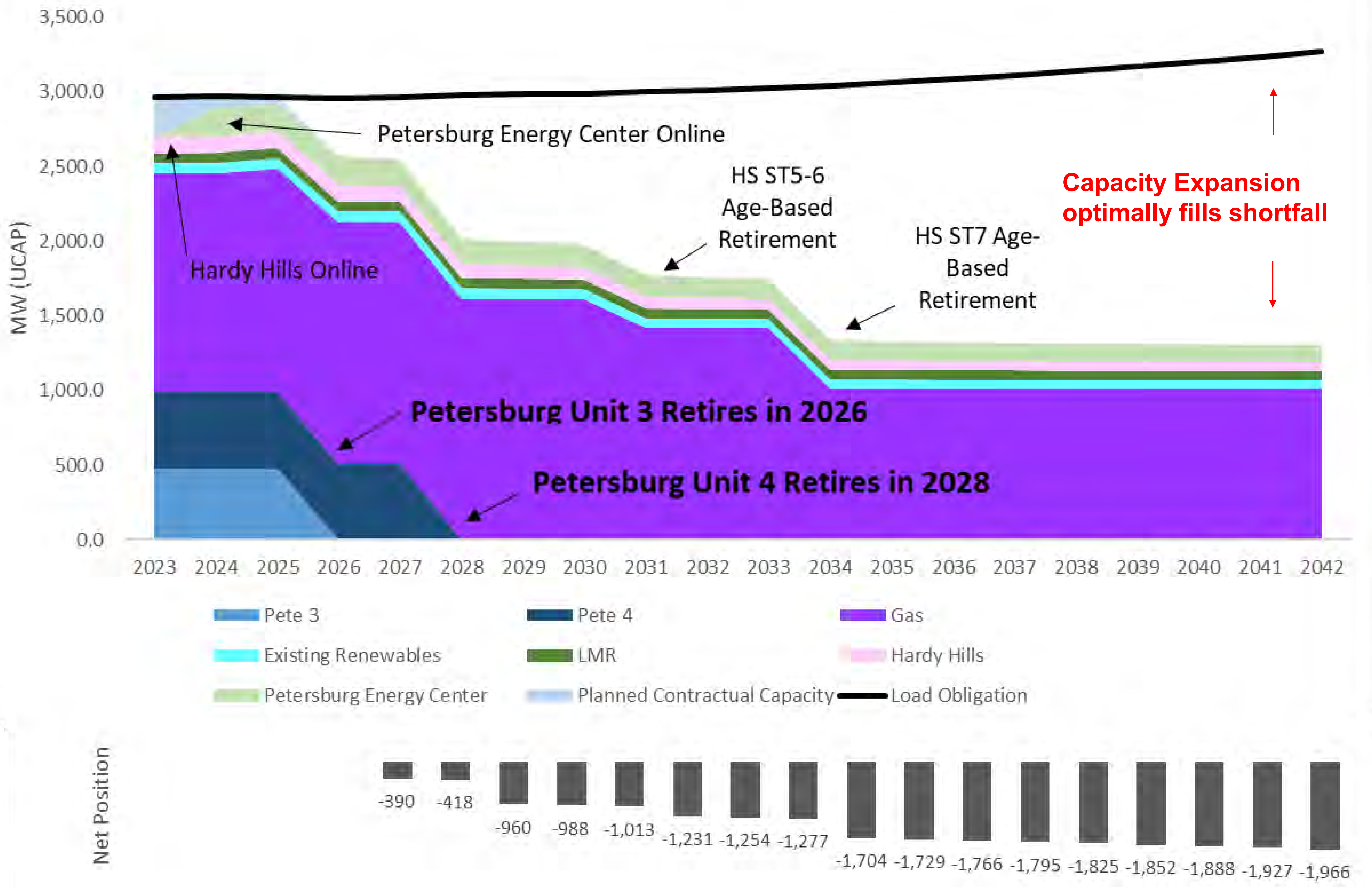
aes Indiana

Strategy: One Petersburg Unit Retires



aes Indiana

Strategy: Both Petersburg Units Retire



AES Indiana

IRP Scenario Framework & Driving Assumptions

IRP Scenarios

AES Indiana will model the four strategies for the generation portfolio across four scenarios:

A. No Environmental Action – “NoEnv”

B. Current Trends (Reference Case) – “Ref”

C. Aggressive Environmental – “AE”

D. Decarbonized Economy – “Decarb”

IRP Commodity Assumptions for the Scenarios

AES Indiana has contracted Horizons Energy to produce custom fundamental commodity forecasts for the four IRP Scenarios – No Environmental Action, Current Trends (Reference Case), Aggressive Environmental and Decarbonized Economy.

- Horizons Energy is modeling AES Indiana's environmental policy and fuel price assumptions associated with each scenario to produce scenario-specific fundamental forecasts for the MISO system.
- Horizons Energy uses the EnCompass model for capacity expansion of the MISO System in producing the custom fundamental forecasts.
- Fundamental Curve modeling results include:
  - ATC, On-Peak and Off-Peak Power Prices
  - Capacity Prices
- **The No Environmental Action, Current Trends (Reference Case), Aggressive Environmental and Decarbonized Economy custom fundamental forecasts are currently in production with Horizons Energy.**

Scenario "NoEnv": No Environmental Action

Driving Assumptions							
Scenario	Load	EV	PV	Power	Gas	Coal	CO2
No Environmental Action	Low	Low	Low	TBD	Low	Base	None

Scenario Narrative

→ Future defined by relaxed environmental regulations, expanded fracking and low demand with low electrification.

→ Inflation persists driving low GDP & customer growth.

→ Continued coal operation combined with expanded gas production result in low gas prices.

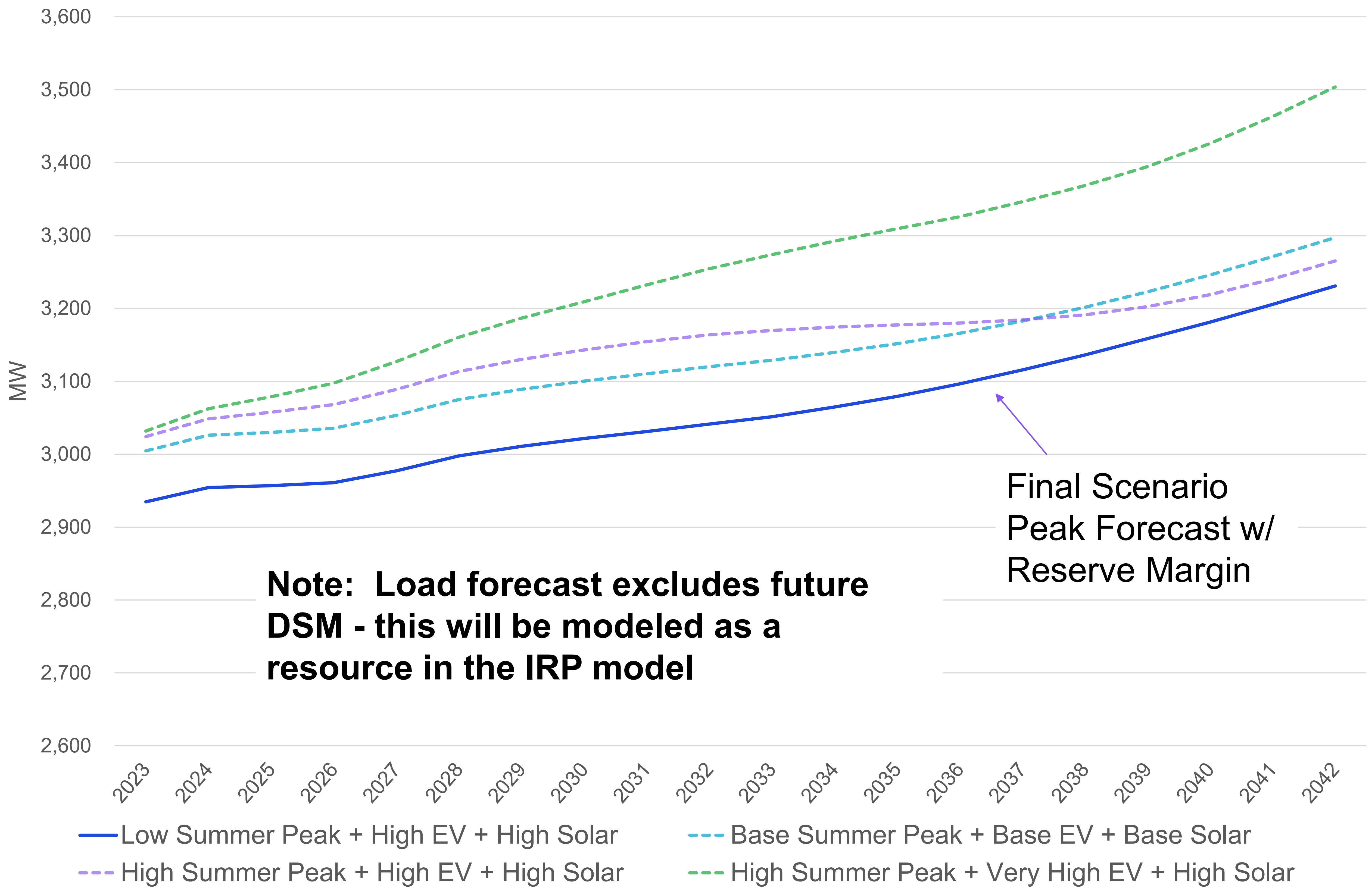
aes Indiana

Scenario "NoEnv": No Environmental Action – Load Assumptions

Load Forecast:
Low Case
Driven by Moody's Economics S3: Alternative Scenario 3 – Downside – 90th Percentile

Electric Vehicle Forecast:
Low Case
EV market share of 12% in 2042

Distributed Solar Forecast:
Low Case
Market adoption of 6% in 2042



aes Indiana

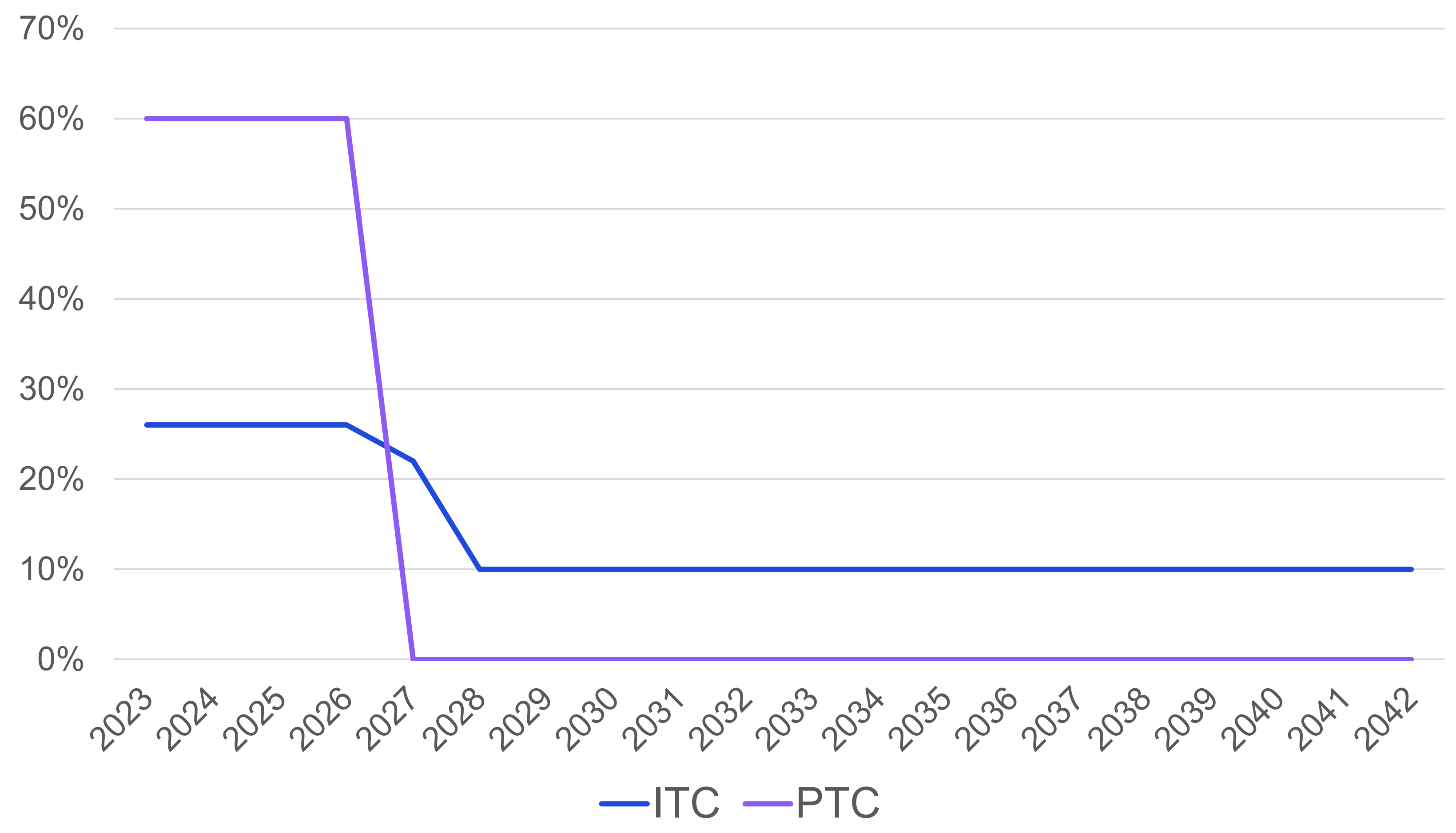
Scenario "NoEnv": No Environmental Action – Environmental Policy Assumptions

ITC: No subsidy extension; Current tax subsidy schedule – declines to 10% by 2028 and remains at 10% through analysis period

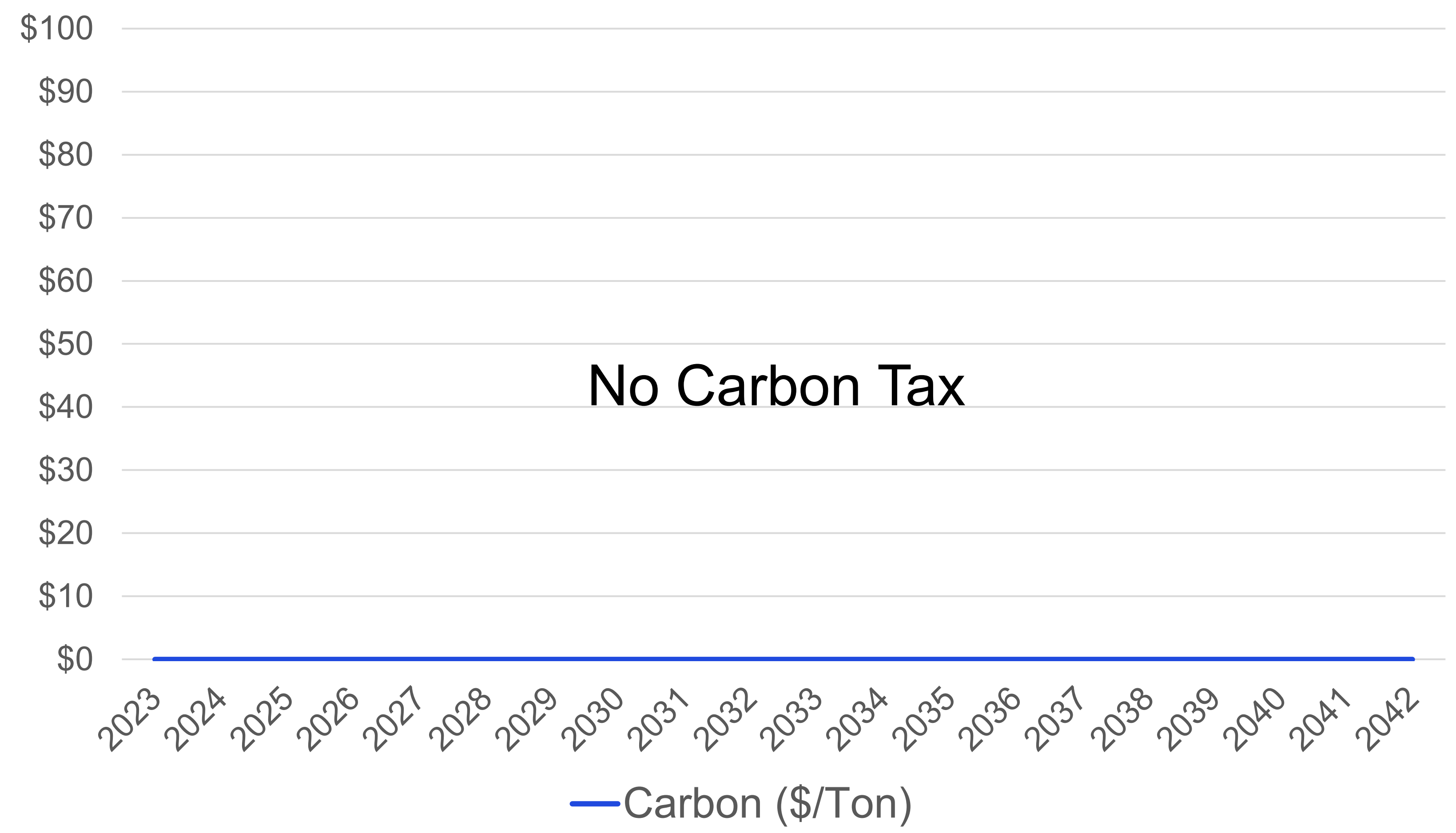
PTC: No subsidy extension; Current tax subsidy schedule – safe harbor period expires in 2027

Carbon: None

Additional Coal-fired Production Costs: None



*Years correspond to years projects first produce energy



Scenario "Ref": Current Trends (Reference Case)

Driving Assumptions							
Scenario	Load	EV	PV	Power	Gas	Coal	CO2
Current Trends	Base	Base	Base	TBD	Base	Base	Low

Scenario Narrative

- Congressional gridlock persists with stalled progress on passing sweeping environmental legislation.
- The ITC and PTC given single year extensions for the next five years.
- Assumes modest price for carbon starting at $6.49/ton in the late 2020s.

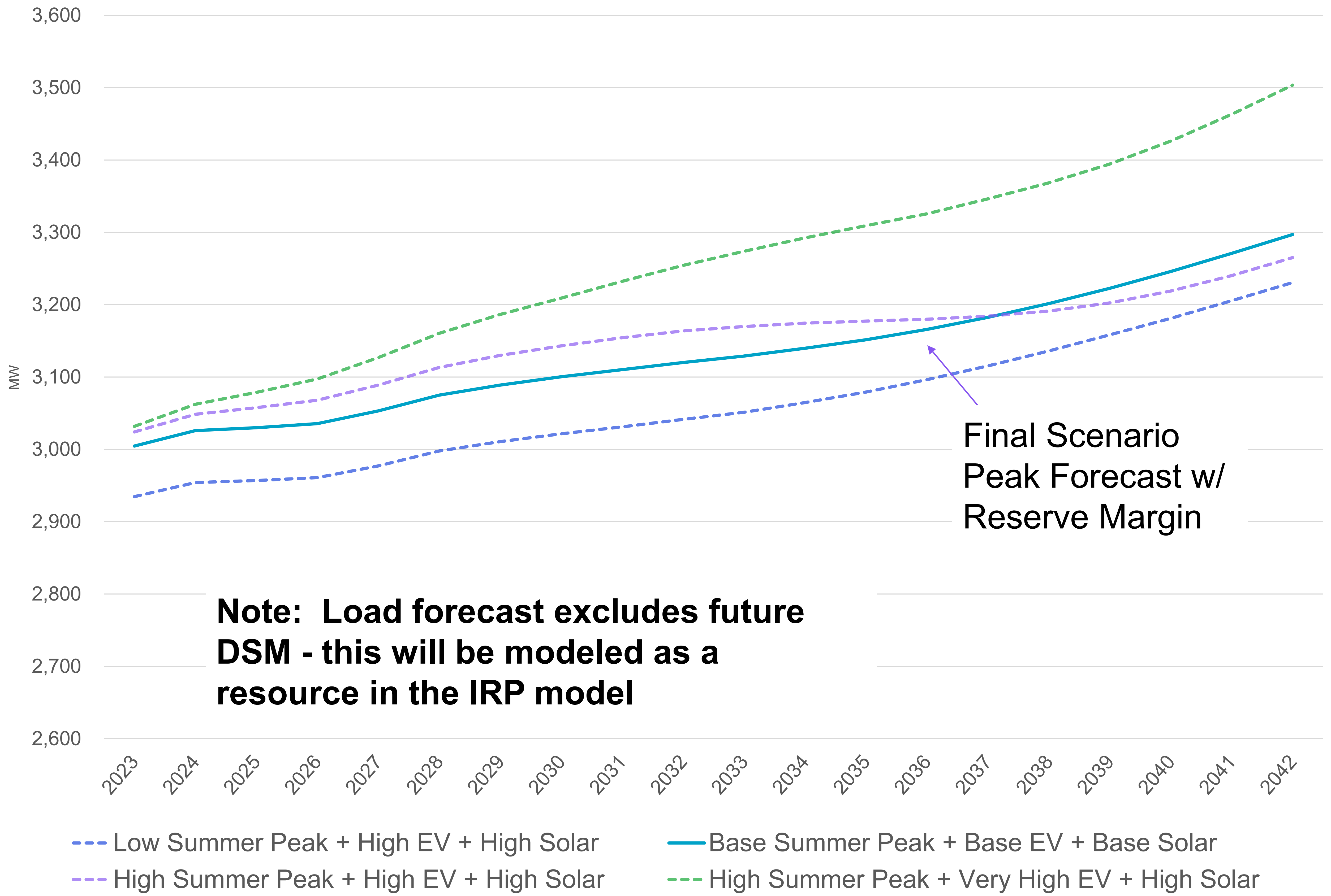
aes Indiana

Scenario “Ref”: Current Trends – Load Assumptions

Load Forecast:
Base Case with base Moody’s economic assumptions

Electric Vehicle Forecast:
Base Case
EV market share of 22% in 2042

Distributed Solar Forecast:
Base Case
Market adoption of 15% in 2042



aes Indiana

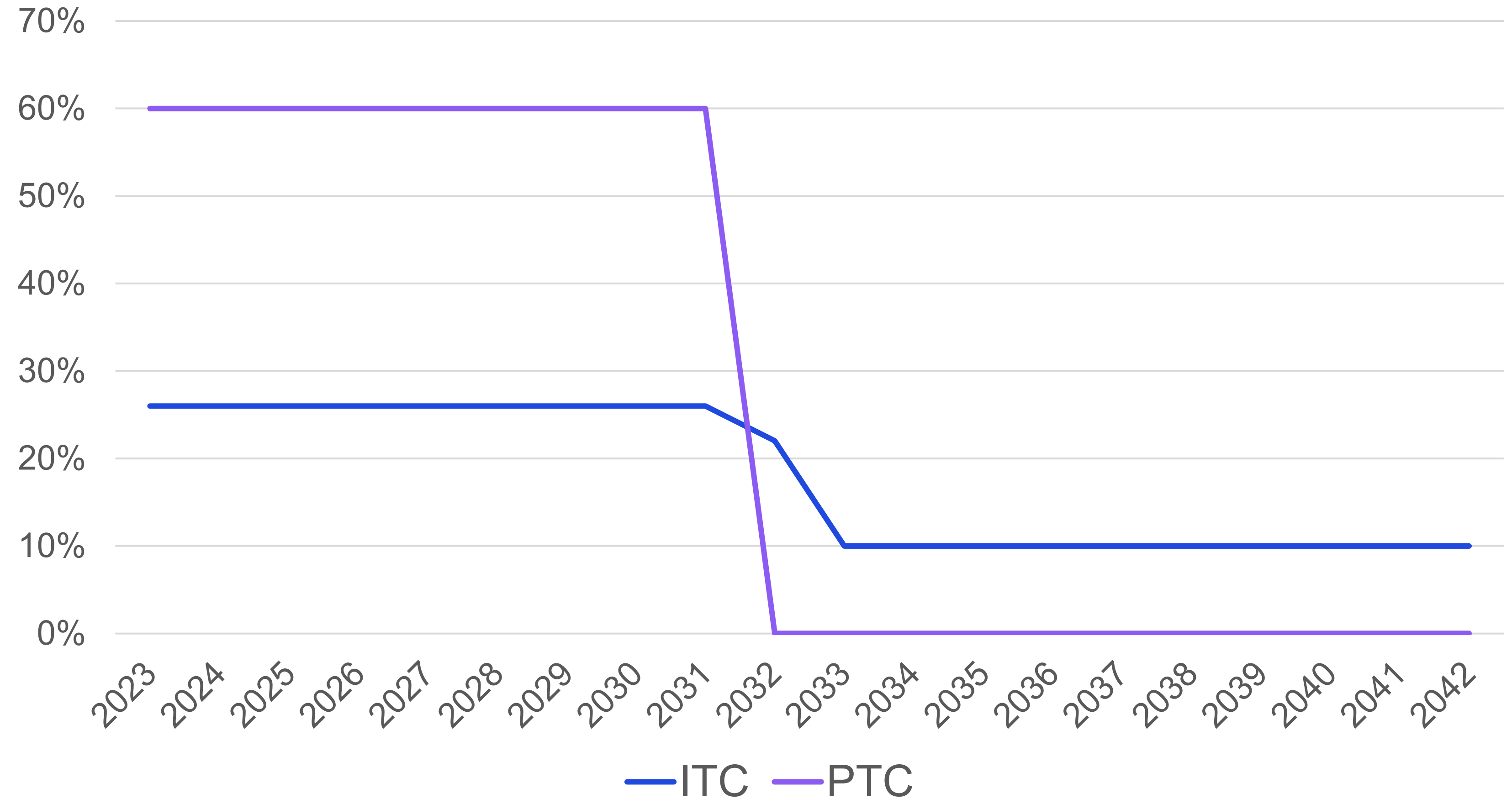
Scenario "Ref": Current Trends – Environmental Policy Assumptions

ITC: Five-year extension – declines to 10% by 2032 and remains at 10% through analysis period

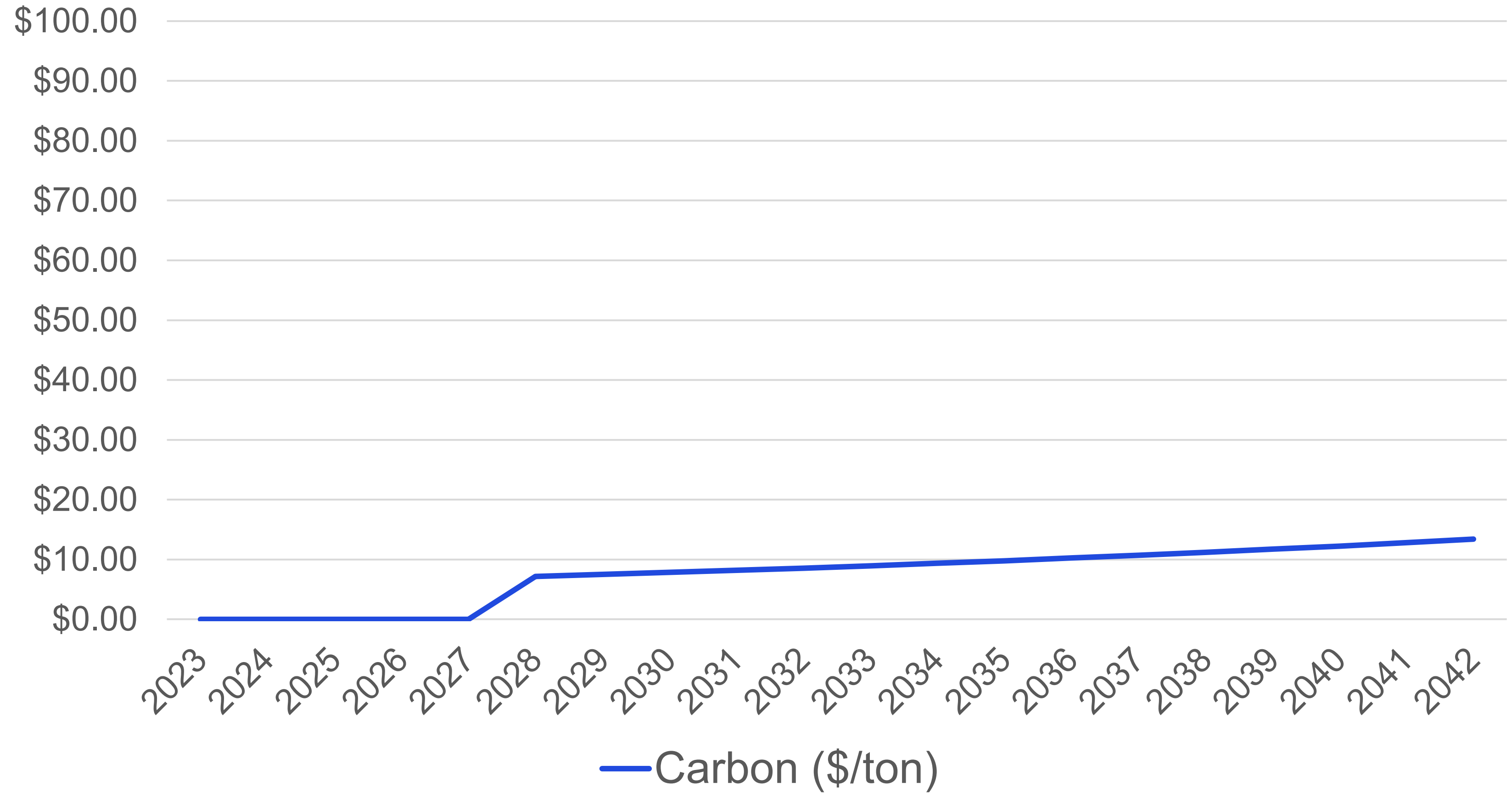
PTC: Five-year extension – safe harbor period expires in 2032

Carbon: Carbon set at $6.49/ton starting in 2028 and escalating at 2.5% through planning period; Carbon price consistent with 1/3 the value of the Social Cost of Carbon as calculated by the U.S. Govt Interagency Working Group on Social Cost of Greenhouse Gases

Additional Coal-fired Production Costs: None



*Years correspond to years projects first produce energy



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

aes Indiana

Scenario “AE”: Aggressive Environmental

Driving Assumptions							
Scenario	Load	EV	PV	Power	Gas	Coal	CO2
Aggressive Environmental	High	High	High	TBD	High	Base	High

Scenario Narrative

→ Congress passes environmental legislation that includes carbon tax starting in 2035.

→ ITC and PTC extensions are consistent with Build Back Better.

→ Includes high demand scenario with high electric vehicle and solar forecasts

→ Near term transition from coal to natural gas results in high gas prices.

Scenario “AE”: Aggressive Environmental – Load Assumptions

Load Forecast:

High Case driven by Moody’s S1: Alternative Scenario 1 – Upside – 10th Percentile

Electric Vehicle Forecast:

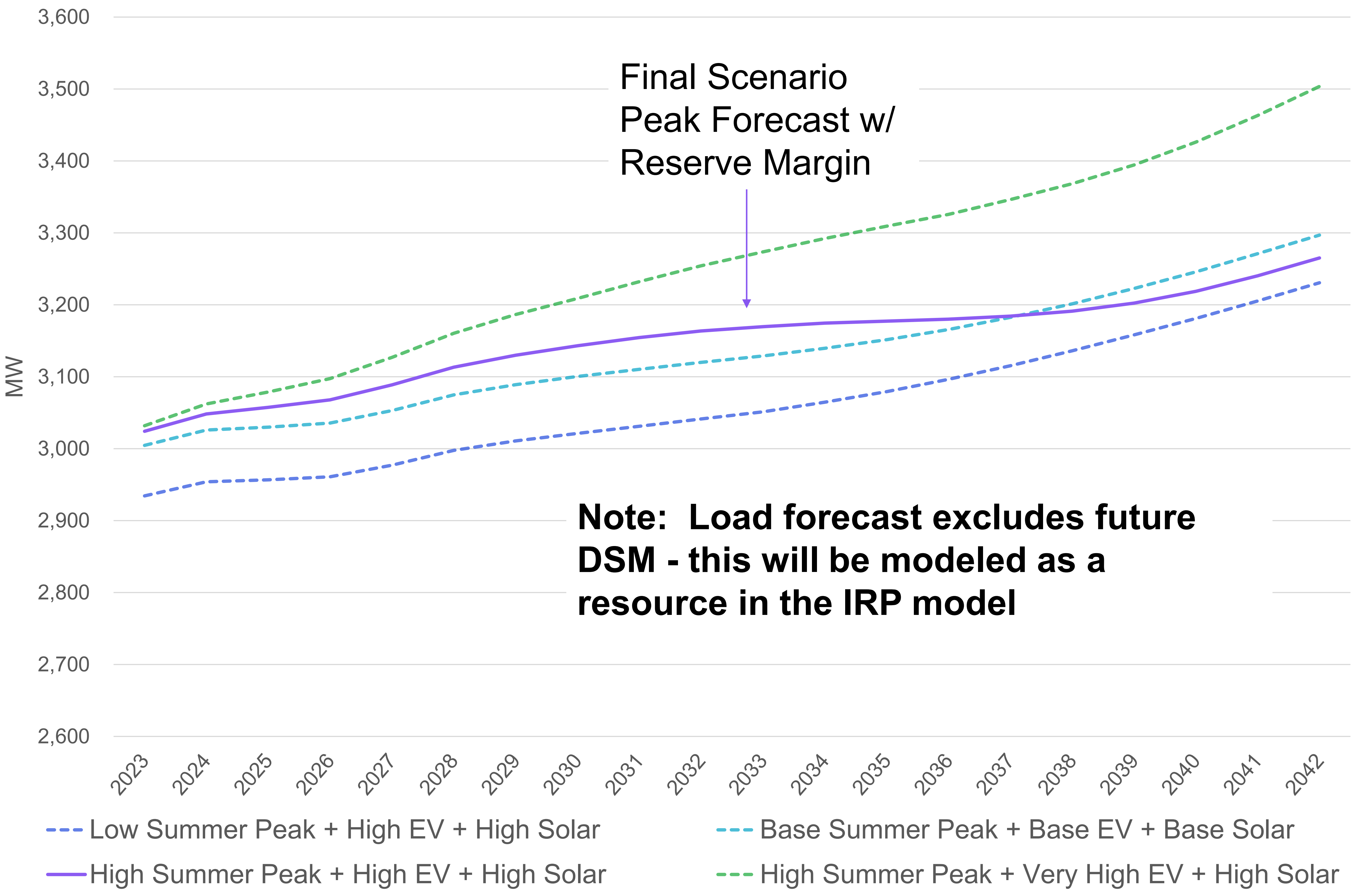
High Case

EV market share of 44% in 2042

Distributed Solar Forecast:

High Case

Market adoption of 29% in 2042



Scenario "AE": Aggressive Environmental – Environmental Policy Assumptions

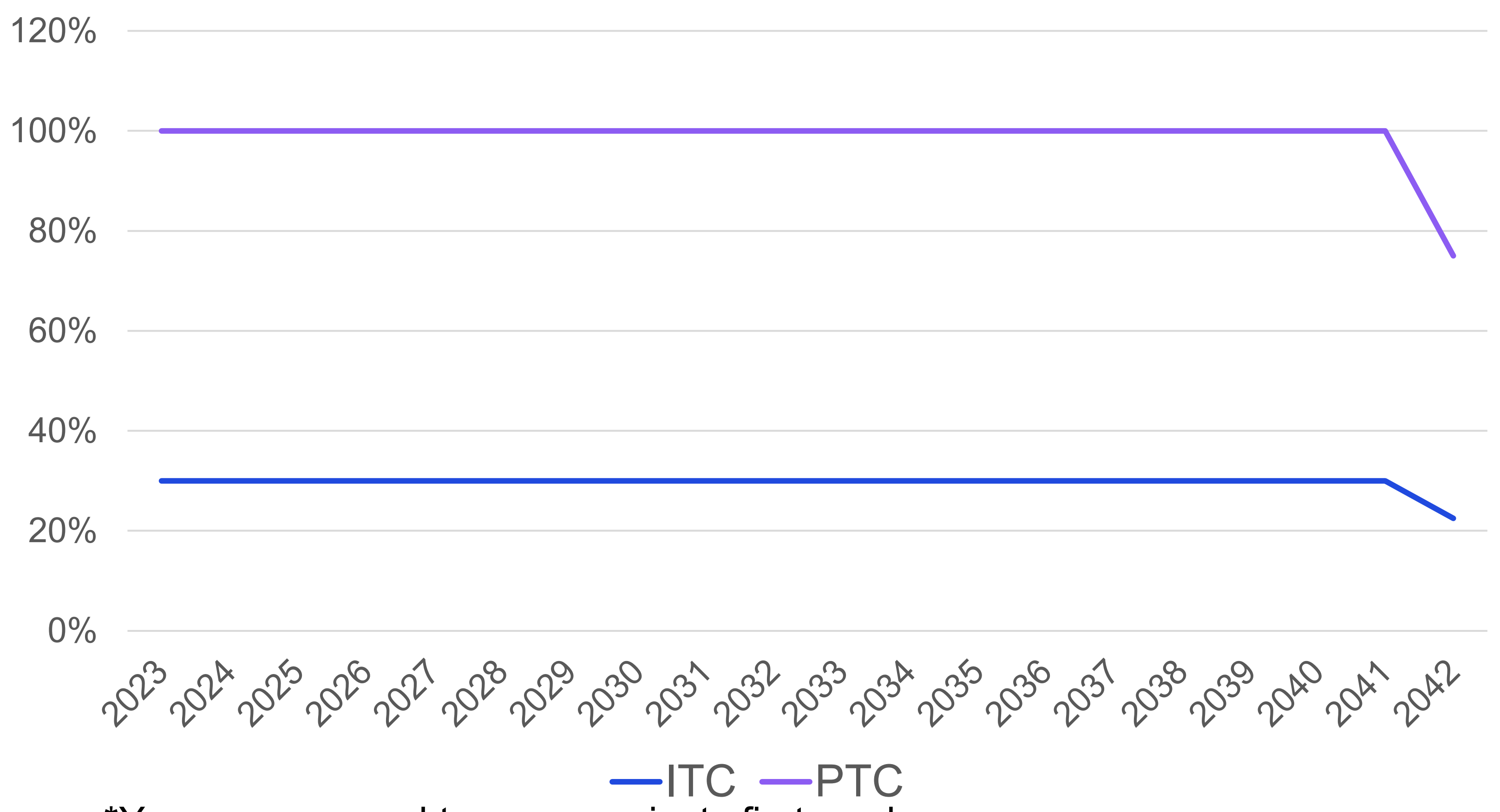
ITC: Ten-year extension – declines to 10% by 2042 and remains at 10% through analysis period

PTC: Ten-year extension – safe harbor period expires in 2042

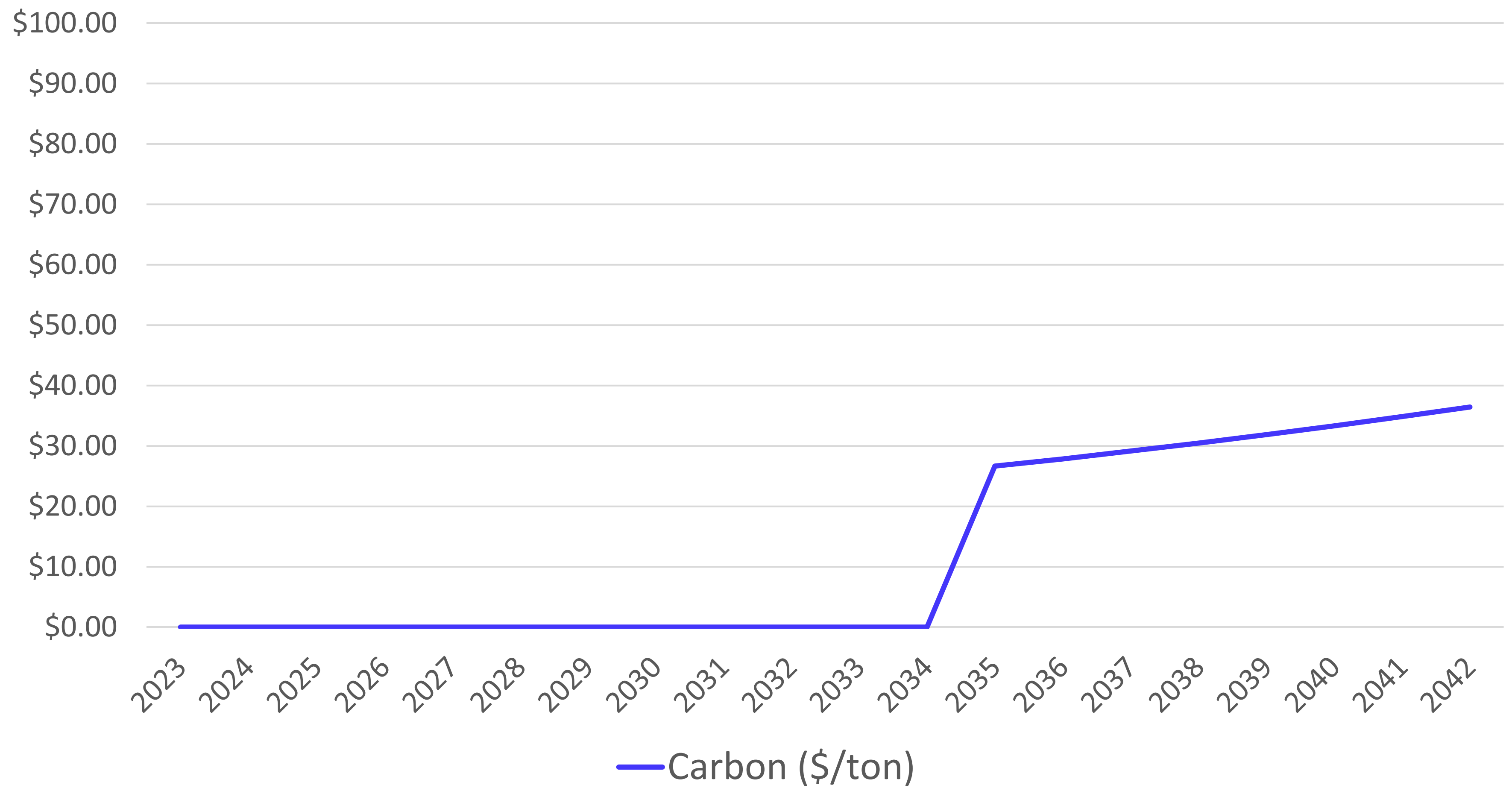
Carbon: Carbon set at $26.64/ton starting in 2035 and escalating at 5% through planning period; Carbon price consistent with the whole value of the Social Cost of Carbon as calculated by the U.S. Govt Interagency Working Group on Social Cost of Greenhouse Gases.

Additional Coal-fired Production Costs:

1 Additional cost for coal ash disposal 2 High Ozone Season NOx price forecast



*Years correspond to years projects first produce energy



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

AES Indiana

Scenario "Decarb": Decarbonized Economy

Driving Assumptions							
Scenario	Load	EV	PV	Power	Gas	Coal	CO2
Decarbonized Economy	High	Very High	High	TBD	Base	Base	None*

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

Scenario Narrative

- Congress passes aggressive decarbonization mandate on power sector with explicit renewable energy targets.
- High ITC/PTC runs through planning horizon.
- Carbon targets achieved through a Renewable Portfolio Standard that targets Net Zero; not a market mechanism like a carbon tax or cap and trade.
- High load driven by electrification
- Base gas prices driven by low demand due to reduced gas generation.

aes Indiana

Scenario "Decarb": Decarbonized Economy – Load Assumptions

Load Forecast:

High Case driven by Moody's S1: Alternative Scenario 1 – Upside – 10th Percentile

Electric Vehicle Forecast:

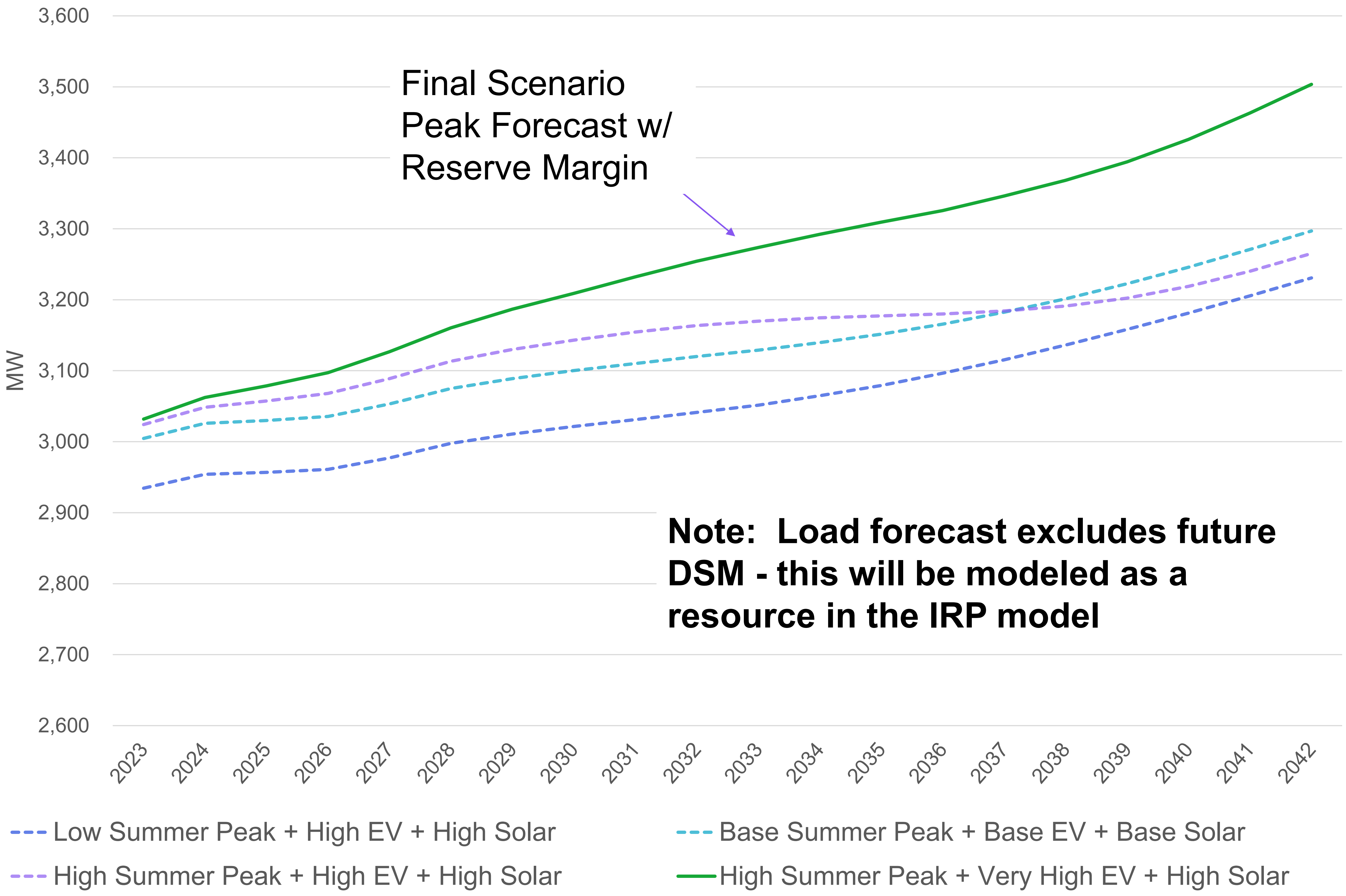
Very High Case

EV market share of 85% in 2042

Distributed Solar Forecast:

High Case

Market adoption of 29% in 2042



Note: Load forecast excludes future DSM - this will be modeled as a resource in the IRP model

Scenario “Decarb”: Decarbonized Economy – Environmental Policy Assumptions

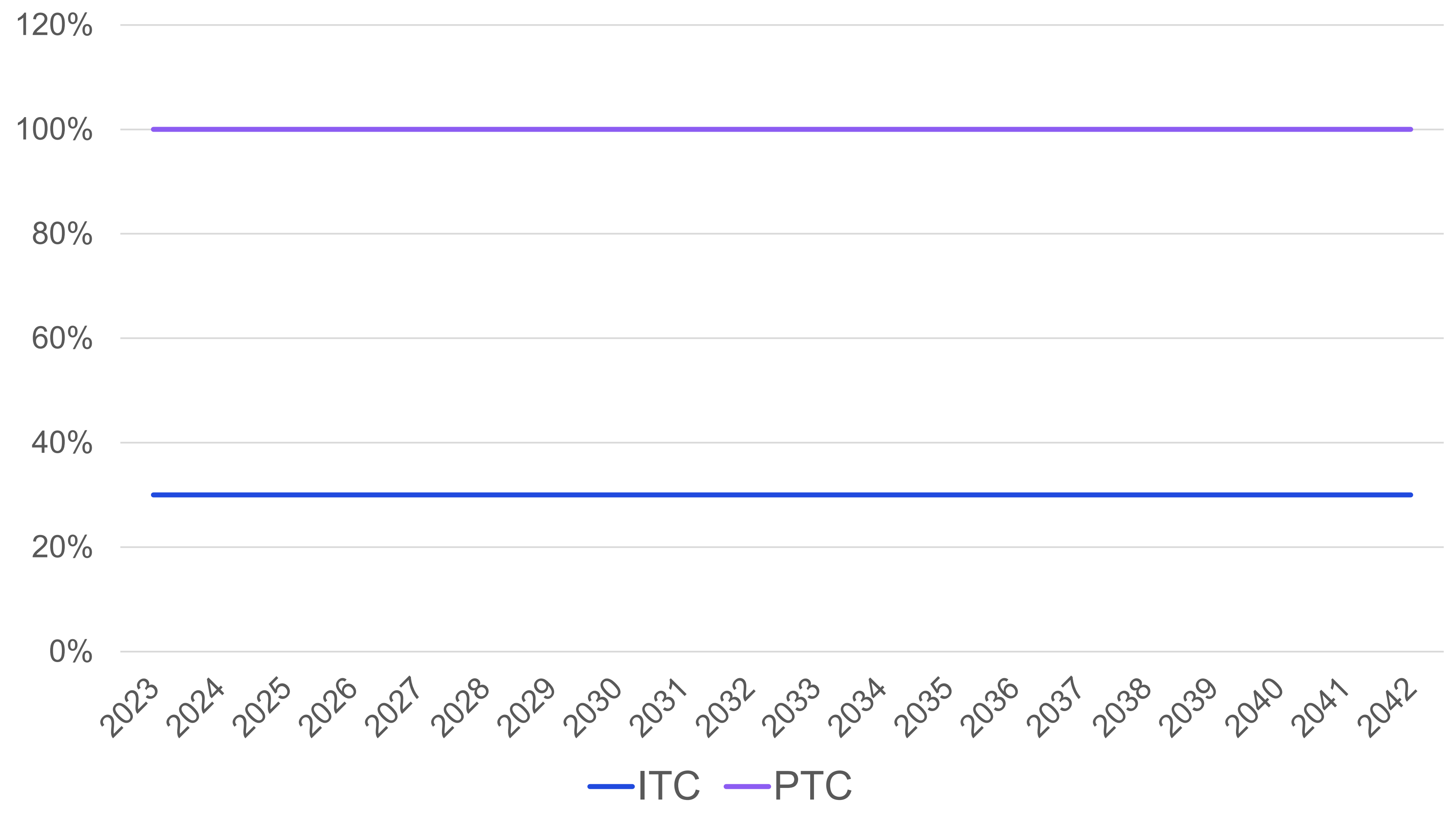
ITC: 30% throughout the planning period

PTC: 100% through entire period

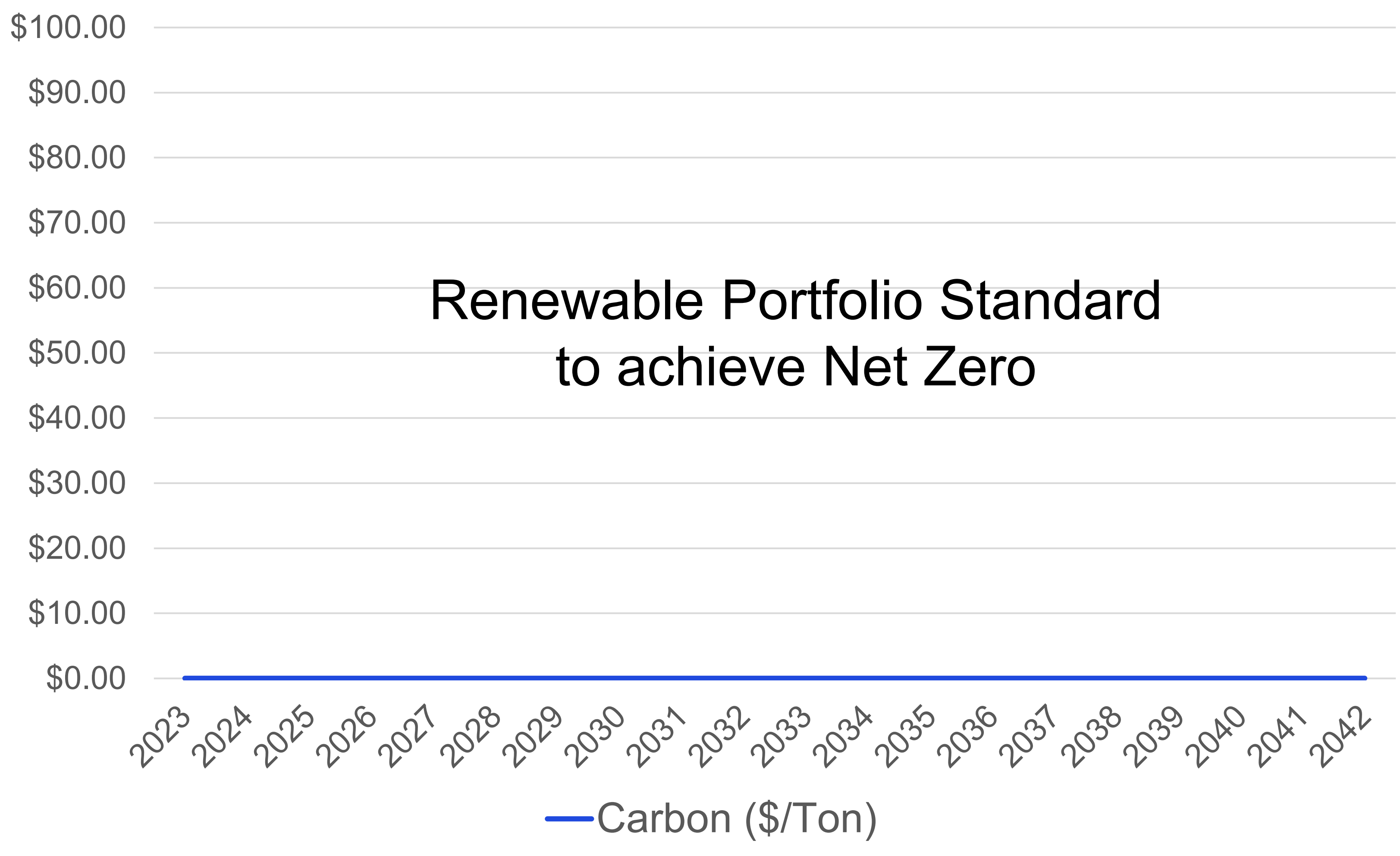
Carbon: No price on Carbon; Renewable Portfolio Standard similar to Clean Energy Performance Program (CEPP)

Additional Coal-fired Production Costs:

1. Additional cost for coal ash disposal
2. High Ozone Season NOx price forecast



*Years correspond to years projects first produce energy



aes Indiana

Summary of Scenario Driving Assumptions

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

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

aes Indiana

Final IRP Portfolio Matrix

AES Indiana

Final Portfolio Matrix

Combining Strategies and Scenarios results in the Portfolio Matrix or framework for IRP evaluation:

		Scenarios			
		No Environmental Action	**Current Trends (Reference Case)**	**Aggressive Environmental**	**Decarbonized Economy**
Generation Strategies	**No Early Retirement**	No Retire/NoEnv	No Retire/Ref	No Retire/AE	No Retire/Decarb
	Pete Refuel to 100% Gas (est. 2025)	Refuel/NoEnv	Refuel/Ref	Refuel/AE	Refuel/Decarb
	One Pete Unit Retires (2026)	One Unit/NoEnv	One Unit/Ref	One Unit/AE	One Unit/Decarb
	Both Pete Units Retire (2026 & 2028)	Both Units/NoEnv	Both Units/Ref	Both Units/AE	Both Units/Decarb

→ The 16 portfolios defined above will be evaluated using a Scorecard that includes cost, environmental, reliability & risk metrics.

→ A Preferred Resource Portfolio will be selected using this rigorous Scorecard evaluation process.

Risk Analysis: Sensitivities & Stochastic

Risk Analysis

→ Key variable sensitivities

- AES Indiana will model sensitivities for key variables to understand how the PVRR may change in a future where the variable looks very different from the IRP assumption, e.g. renewable capital cost sensitivity.

→ Portfolio sensitivities

- AES Indiana will model environmental policy sensitivities on the optimized capacity expansion results from the Current Trends (Reference Case) to understand how the PVRR may change in a very different policy future.
- 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?"

→ Stochastic Analysis

- AES Indiana will run a stochastic analysis on fuel prices, energy prices and load in order to understand the risk to PVRR in the Reference Case from these key IRP variables.

Further detail regarding the Risk Analysis will be presented in Public Advisory Meeting #3.

Final Q&A and Next Steps

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 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

aes Indiana

APPENDIX

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
- 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
- CCS: Carbon Dioxide Capture and Storage
- CDD: Cooling Degree Day
- COD: Commercial Operation Date
- CONE: Cost of New Entry
- CP: Coincident Peak
- CPCN: Certificate of Public Convenience and Necessity
- CT: Combustion Turbine
- CVR: Conservation Voltage Reduction
- DER: Distributed Energy Resource
- DG: Distributed Generation
- DGPV: Distributed Generation Photovoltaic System
- DLC: Direct Load Control
- DOE: U.S. Department of Energy
- DR: Demand Response
- DRR: Demand Response Resource
- DSM: Demand-Side Management
- 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
- EV: Electric Vehicle
- GDP: Gross Domestic Product
- GT: Gas Turbine
- HDD: Heating Degree Day
- HVAC: Heating, Ventilation, and Air Conditioning
- IAC: Indiana Administrative Code
- IC: Indiana Code
- ICAP: Installed Capacity
- ICE: Internal Combustion Engine
- IRP: Integrated Resource Plan
- ITC: Investment Tax Credit
- IURC: Indiana Regulatory Commission
- kW: Kilowatt
- kWh: Kilowatt-Hour
- LED: Light Emitting Diode
- LMR: Load Modifying Resource
- LNBL: Lawrence Berkeley National Laboratory
- Max Gen: Maximum Generation Emergency Warning
- MAP: Maximum Achievable Potential
- MIP: Mixed Integer Programming
- MISO: Midcontinent Independent System Operator
- MPS: Market Potential Study
- MW: Megawatt
- NDA: Nondisclosure Agreement
- NOX: Nitrogen Oxides
- NPV: Net Present Value
- NREL: National Renewable Energy Laboratory
- NTG: Net to Gross
- PPA: Power Purchase Agreement
- PRA: Planning Resource Auction
- 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
- REC: Renewable Energy Credit
- REP: Renewable Energy Production
- RFP: Request for Proposals
- RIIA: MISO's Renewable Integration Impact Assessment
- SAC: MISO's Seasonal Accredited Capacity
- SCR: Selective Catalytic Reduction System
- SMR: Small Modular Reactors
- ST: Steam Turbine
- SUFG: State Utility Forecasting Group
- TRM: Technical Resource Manual
- UCT: Utility Cost Test
- UCAP: Unforced Capacity
- WTP: Willingness to Participate
- XEFORd: Equivalent Forced Outage Rate Demand excluding causes of outages that are outside management control

Replacement Resource Cost Assumptions Summary Table (of all parameters by tech type)

	Wind	Solar	Storage	Solar + Storage	CCGT	Frame CT	Aero CT	Reciprocating Engine
Fuel type:	Wind	Solar	Battery	Solar + Battery	Natural Gas	Natural Gas	Natural Gas	Natural Gas
Unsubsidized Capital Cost ($/kWac):	$1,451	$1,111	$1,310	$1,126	$1,026	$872	$1,335	$1,283
*Subsidized Capital Cost ($/kWac):	$1,002	$803	N/A	$882	N/A	N/A	N/A	N/A
Fixed O&M ($/kW-yr):	$37	$21	$36	$25	$32	$30	$36	$46
Variable O&M ($/MWh):	$0	$0	$0	$0	$2	$1	$5	$6
Grid Connection Cost ($/kWac):	$26	$54	$59	$54	$30	$30	$30	$30
**Tax Equity Cost ($/kWac):	$59	$59	N/A	$59	N/A	N/A	N/A	N/A
Size (POI MW):	50	25	20 MW | 80 MWh	25 MW POI, 32.5 MWdc Solar, 12.5 MW | 50 MWh Battery	325	100	90	54
Asset Useful Life (years):	30	35	20	31	30	20	20	20
Capacity Factor:	33.6-40.4%	24.5%	N/A	20.0%	Varies	Varies	Varies	Varies
Summer ELCC (2025):	7%	59%	96%	100%	94%	96%	96%	96%
Summer Capacity Credit (2025):	4	15	19	25	306	96	86	52
Heat Rate at Max Econ Load (Btu/kWh):	N/A	N/A	N/A	N/A	6,700	10,000	8,200	7,400
Ramp Rate (MW/min):	N/A	N/A	N/A	N/A	20	12	43	37
WACC:	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%
Estimated LCOE (2022$/MWh):	$30	$38	$113	$53	$44	$120	$69	$61

*Includes 26% ITC for solar and $15/MWh PTC for wind consistent with the Current Trends Scenario
**Cost only considered when resource is subsidized
***Storage LCOS assumes one full discharge per day; Dispatchable resources LCOE calculations highly dependent on capacity factor

aes Indiana

DSM Market Potential Study

APPENDIX SLIDES

Demand Response Assumptions – Residential Load Reduction

Program	Residential Load Reduction Per Participant
DLC Central AC Switch	0.972 kW
DLC Central AC Thermostat	0.846 kW
DLC Smart Appliances	0.072 kW
DLC Water Heaters	0.4 kW Summer, 0.8 kW Winter
DLC Electric Space Heaters	1 kW
DLC Electric Vehicle Chargers	0.63 kW
Battery Energy Storage	3 kW
Time of Use Rate with Enabling Technology	8% of CP billing demand
Time of Use Rate without Enabling Technology	5.2% of CP billing demand
Behavior DR	12.9% of CP billing demand

GDS Associates, Inc. ENGINEERS & CONSULTANTS brightline GROUP aes Indiana

Demand Response Assumptions – Non-Residential Load Reduction

Program	Non-Residential Load Reduction Per Participant
DLC Central AC Switch	1.103 kW
DLC Central AC Thermostat	0.96 kW
DLC Water Heaters	0.6 kW Summer, 1.2 kW Winter
DLC Electric Space Heaters	1.5 kW
DLC Lighting	8.9% of CP billing demand
Curtail Agreements	5% of CP billing demand for day ahead, 3% day of
Demand Bidding	7% of CP billing demand
Capacity Bidding	19.5% of CP billing demand
Time of Use Rate with Enabling Technology	3.8% of CP billing demand
Time of Use Rate without Enabling Technology	2% of CP billing demand

Demand Response Assumptions – Residential Costs

Program	Equipment & Installation Cost	Incentive Cost
DLC Central AC One-Way Communicating Switch	$220	$20/participant/year
DLC Central AC Two-Way Communicating Switch	$245	$20/participant/year
DLC Central AC Thermostat	$300	$20/participant/year
DLC Smart Appliances	$245	$20/participant/year
DLC Water Heaters	$300	$20/participant/year
DLC Electric Space Heaters	$0; assumed must be participating in DLC AC program	$20/participant/year
DLC Electric Vehicle Chargers	$0; assumed must have Level 2 charger	$50/participant/year
Battery Energy Storage	$12,385	$0
Time of Use Rate with Enabling Technology	$300	$0
Time of Use Rate without Enabling Technology	$0	$0
Behavior DR	$0	$0.75/kWh

Demand Response Assumptions – Non-Residential Costs

Program	Equipment & Installation Cost	Incentive Cost
DLC Central AC One-Way Communicating Switch	$220	$30/participant/year
DLC Central AC Two-Way Communicating Switch	$245	$30/participant/year
DLC Central AC Thermostat	$300	$30/participant/year
DLC Water Heaters	$300	$30/participant/year
DLC Electric Space Heaters	$0; assumed must be participating in DLC AC program	$30/participant/year
DLC Lighting	$1,900	
Curtail Agreements	$0	Starts at $87/kW-yr for MAP and $47/kW-yr for RAP; increases by 2% per year
Demand Bidding	$0	$0.5/kWh-yr
Capacity Bidding	$0	$8.50/kW-yr
Time of Use Rate with Enabling Technology	$300	$0
Time of Use Rate without Enabling Technology	$0	$0
Ice Energy Storage Rate	$55,000	$0

Demand Response Assumptions – Adoption Rates

Residential Adoption Rates

Program	MAP	RAP
DLC Central AC (Switch and Thermostat Total)	71%	41%
DLC Smart Appliances	31%	20%
DLC Water Heaters	65%	35%
DLC Electric Space Heaters	20%	15%
DLC Electric Vehicle Chargers	72%	27%
Battery Energy Storage	10%	5%
Time of Use Rate (with and without Enabling Technology total)	64%	46%
Behavior DR	93%	21%

Non-Residential Adoption Rates

Program	MAP	RAP
DLC Central AC (Switch and Thermostat Total)	14%	3%
DLC Water Heaters	16%	7%
DLC Electric Space Heaters	14%	3%
DLC Lighting	14%	3%
Demand Bidding	8%	1%
Capacity Bidding	21%	3%
Time of Use Rate (with and without Enabling Technology total)	74%	13%
Ice Energy Storage Rate	81%	16%

2022 Integrated Resource Plan (IRP)

Public Advisory Meeting #3

6/27/2022

aes Indiana

Agenda and Introductions

Stewart Ramsay, Managing Executive, Vanry & Associates

Agenda

Time	Topic	Speakers
Morning **Starting at 10:00 AM**	Virtual Meeting Protocols and Safety, Schedule	Chad Rogers, Senior Manager, Regulatory Affairs, AES Indiana
	IRP Midway Touchpoint	Kristina Lund, President & CEO, AES Indiana
	Stakeholder Presentations	Wendy Bredhold, Senior Campaign Representative, Sierra Club Ray Wilson, Faith in Place
	IRP Schedule & Meeting #2 Recap	Erik Miller, Manager, Resource Planning, AES Indiana
	2022 All-Source RFP & Replacement Resource Cost Update	Erik Miller, Manager, Resource Planning, AES Indiana
	Commodity Forecasts	Erik Miller, Manager, Resource Planning, AES Indiana
	RTO Reliability Planning: Resource Adequacy & Seasonal Construct	Lynn Hecker, Senior Manager, Resource Adequacy Policy and Analytics, MISO
Break **12:00 PM – 12:30 PM**	Lunch	
Afternoon **Starting at 12:30 PM**	Modeling Reliability Assumptions	Erik Miller, Manager, Resource Planning, AES Indiana
	Reliability Analysis	Hisham Othman, VP Transmission and Regulatory Consulting, Quanta
	Portfolio Metrics & Scorecard	Erik Miller, Manager, Resource Planning, AES Indiana
	AES Indiana Distribution System Planning	Kathy Storm, Vice President, US Smart Grid, AES Indiana Mike Russ, Senior Manager, T&D Forecasting, AES Indiana
	Final Q&A and Next Steps	

Virtual Meeting Protocols and Safety

Chad Rogers, Senior Manager, Regulatory Affairs, AES Indiana

IRP Team Introductions

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

AES Indiana Legal Team

Nick Grimmer, Indiana Regulatory Counsel, AES Indiana

Teresa Morton Nyhart, Counsel, Barnes & Thornburg LLP

Welcome to Today's Participants

IBEW Local Union 1395
Indiana Chamber
Indiana DG
Indiana Distributed Energy Alliance
Indiana Energy Association
Indiana Utility Regulatory Commission
Indiana State Conference of the NAACP
IUPUI
NIPSCO
NuScale Power
Office of Utility Consumer Counselor
Power Takeoff
Purdue - State Utility Forecasting Group
Ranger Power
Reliable Energy
Rolls-Royce/ISS
Sierra Club
Solar United Neighbors
Synapse Energy Economics
Wartsila

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

aes Indiana

Virtual Meeting Best Practices

- 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

Safety first

Highest standards

All together

aes Indiana

Our safety beliefs

1. Safety comes first for our people, our contractors and our communities.

2. All occupational incidents can be prevented.

3. Working safely is a condition of employment.

4. All AES people and contractors have the right and obligation to stop work when they identify a situation they believe to be unsafe

We can all be safety leaders.

AES

- Fortune 200 company with operations in 14 countries across 4 continents.
- Track record of innovation in the technologies that are transforming the energy sector.
- AES is a global energy company and with the addition of 5 GW of new renewables in 2021, is now positioned as the fastest growing US renewables developer and the largest supplier of corporate renewables contracts in the world.
- AES announced a target to exit coal by year-end 2025 at the global portfolio level, subject to meeting regulatory obligations. The exit may be achieved through asset sales, fuel conversions or retirements.

AES Indiana

- 20-year IRP plan created with stakeholder input.
- Modeling and analysis culminates in a preferred resource portfolio and a short-term action plan.
- The need for a utility to engage in a rigorous stakeholder process and describe how the utility plans to deliver safe, reliable and efficient electricity at just and reasonable rates is a legal requirement in Indiana and is an obligation AES Indiana will meet.

Leading the inclusive, clean energy transition

1. AES Indiana has a diverse power generation portfolio that serves our customers' needs today and well into the future.

2. Our 2019 IRP projected that AES Indiana would achieve a reduction in carbon intensity of more than 40% from 2015 to 2025.

3. AES Indiana has been incorporating new technologies and fuels into its generation fleet for more than a decade.
   - Signed power purchase agreements with wind farms back beginning in 2009
   - Converted Harding Street from coal to natural gas
   - Retired Eagle Valley coal and started operations of a new CCGT in 2018
   - Announced plans to retire Petersburg Unit 1 in 2021 and Unit 2 in 2023 and signed the acquisitions of Hardy Hills (195 MW solar project) and the Petersburg Energy Center (250 MW solar and 180 MWh energy storage project)

4. AES Indiana is committed to safety and compliance of all environmental regulations and will responsibly close ash ponds in the manner required by Indiana state law.

aes Indiana

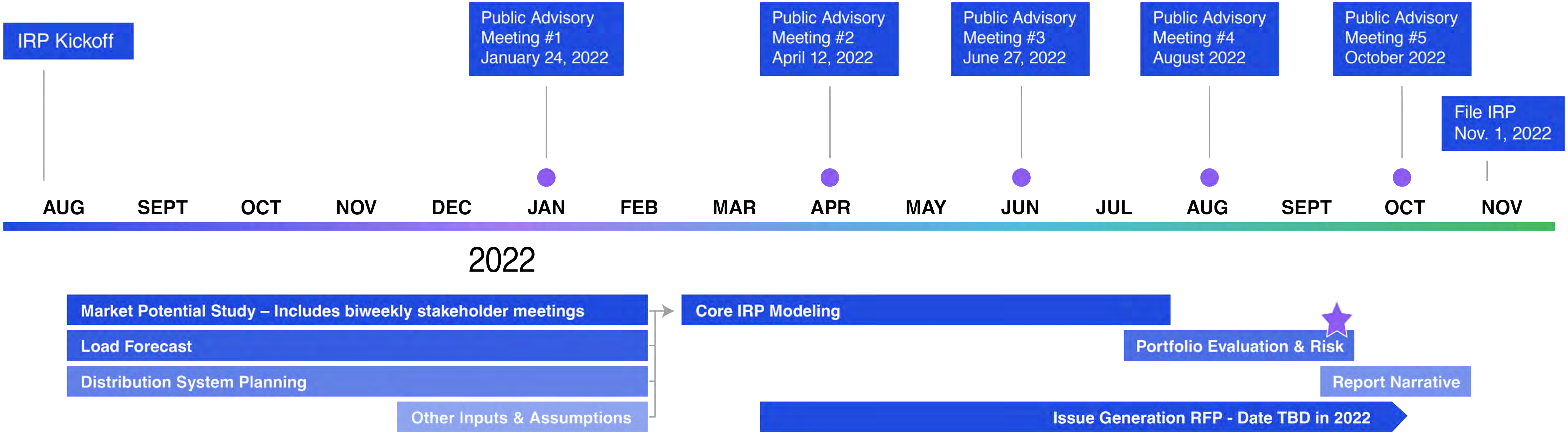
Stakeholder Presentations

Stakeholder Presentations

AES Indiana

IRP Schedule & Meeting #2 Recap

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.

aes Indiana

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 - August

- Preliminary Modeling Results
- Risk Analysis
- Preliminary Scorecard Results

Public Advisory Meeting #5 - October

- 2022 Modeling Insights
- Preferred Resource Portfolio & Short-Term Action Plan

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 date TBD in 2022

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

Other Inputs & Assumptions

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

IRP Submitted Nov. 1, 2022

IRP-driven Filings

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

Meeting #2 Recap: Portfolio Matrix Update

Combining Strategies and Scenarios results in the Portfolio Matrix or framework for IRP evaluation:

		Scenarios			
		No Environmental Action	**Current Trends (Reference Case)**	**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

→ The Current Trends portfolios defined above will be evaluated using a Scorecard that includes cost, environmental, reliability & risk metrics.

→ A Preferred Resource Portfolio will be selected using this rigorous Scorecard evaluation process.

Other Updates from Meeting #2

1) Energy Efficiency Bundles

→ After stakeholder collaboration AES Indiana decided to split Efficient Products and Residential Vintage 2 & 3 into higher and lower cost bundles to provide the opportunity for additional cost-effective energy efficiency to get selected.

BEFORE

	Vintage 1 2024 - 2026	Vintage 2 2027 - 2029	Vintage 3 2030 - 2042
Residential	Efficient Products	All Residential (excluding IQW)	All Residential (excluding IQW)
	Behavioral		
	School Education		
	Appliance Recycling		
	Multifamily		
	*IQW	*IQW	*IQW
C&I	Prescriptive	All C&I	All C&I
	Custom		
	Custom RCx		
	Custom SEM		

*IQW Program will be predefined in the IRP modeling

AFTER

	Vintage 1 2024 - 2026	Vintage 2 2027 - 2029	Vintage 3 2030 - 2042
Residential	Efficient Products - Lower Cost	Lower Cost Residential (excluding 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	All C&I	All C&I
	Custom		
	Custom RCx		
	Custom SEM		

*IQW Program will be predefined in the IRP modeling

2022 All-Source RFP & Replacement Resource Costs Update

2022 All-Source Generation RFP

Summary of All-Source RFP Responses

Technology	# of Projects
Solar	14
Wind	
Thermal-Aero CT	
Solar + Storage	
Storage	
TOTAL	24

****Confidential** Competitively Sensitive Information**

A *<u>project</u>* *is defined as a unique site and each site may have multiple* *<u>proposal</u>* *offerings (PPA, Asset Transfer, etc.).*

All-Source RFP Capacity Summary

- Low volume of wind capacity possibly due to limited siting availability in Indiana and uncertainty around PTC
- Capacity volumes help to inform resource build constraints included in the IRP planning model (EnCompass)

Commodity Forecasts

IRP Commodity Price Updates

- In response to stakeholder comment and in order to ensure reasonable forecasts are included in this IRP – AES Indiana has had Horizon Energy update the custom fundamental power price studies using the Spring gas and coal price outlook. Thus, this IRP reflects the recent upward trend in gas, coal and power prices. The following commodity review slides reflect this update.

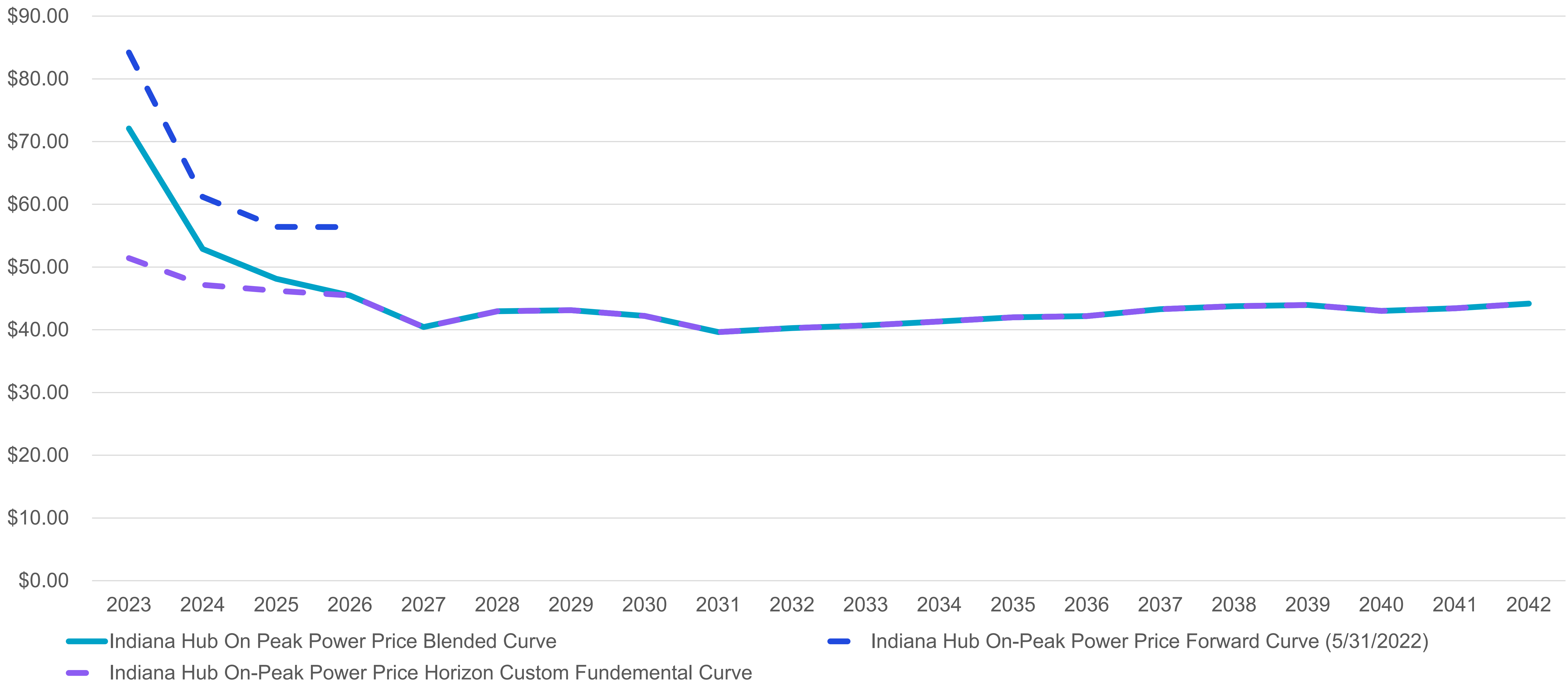
Summary of Scenario Commodity Assumptions

Scenario	Gas	Coal	Power	Capacity	NOx	CO_2
No Environmental Action – "No Env"	Low	Base	Custom	Base	Base	None
Current Trends (Reference Case) – "Ref"	Base	Base	Custom	Base	Base	Base
Aggressive Environmental – "AE"	High	Base	Custom	Base	High	High
Decarbonized Economy – "Decarb"	Base	Base	Custom	Base	High	None – Clean Energy Mandate

Methodology: Blending Curves

Power prices, gas prices and coal prices are a blend of forward market curves and Fundamental Curves from Horizon Energy.

Blending prices in near-term captures near-term market impacts.

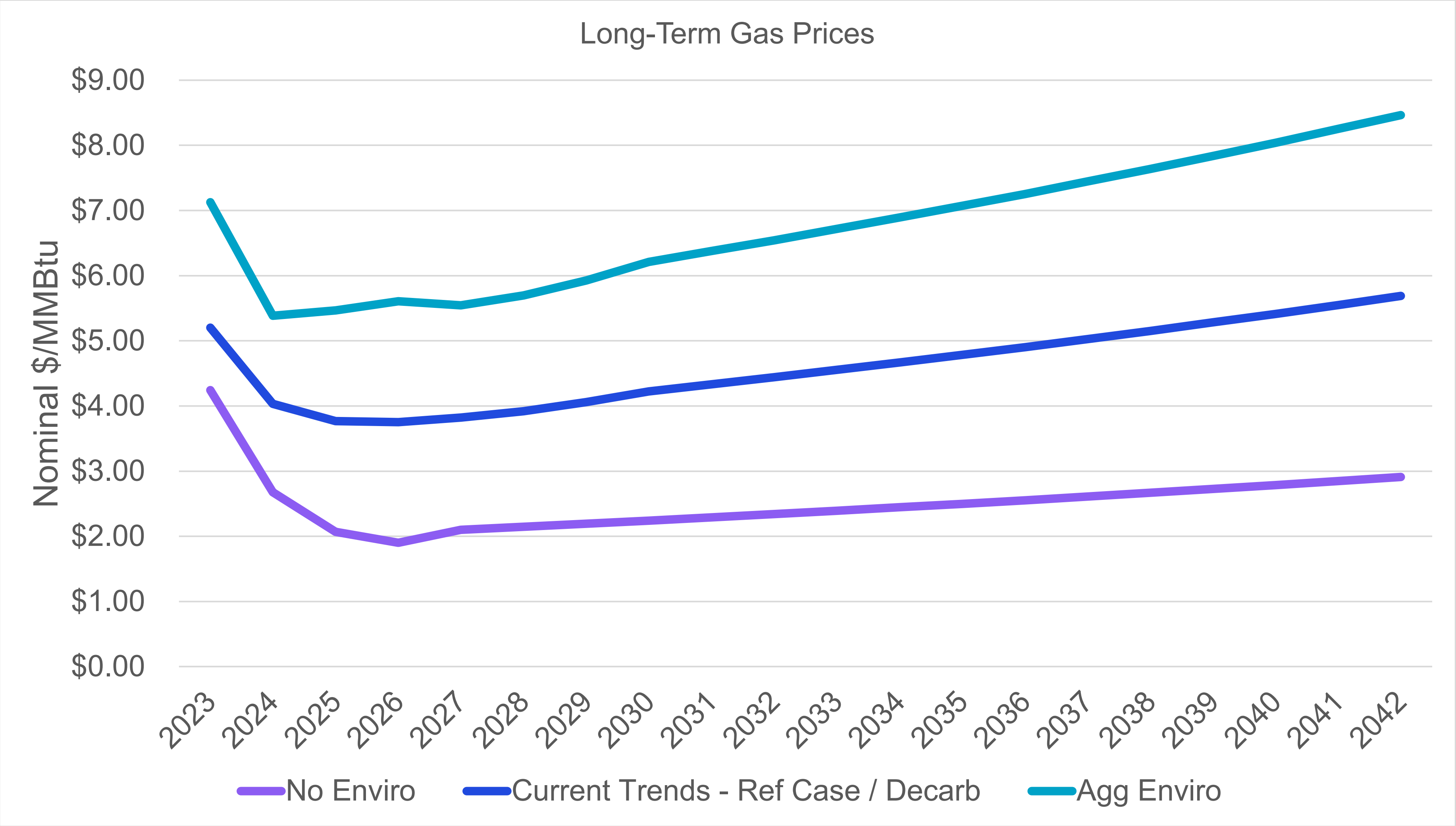


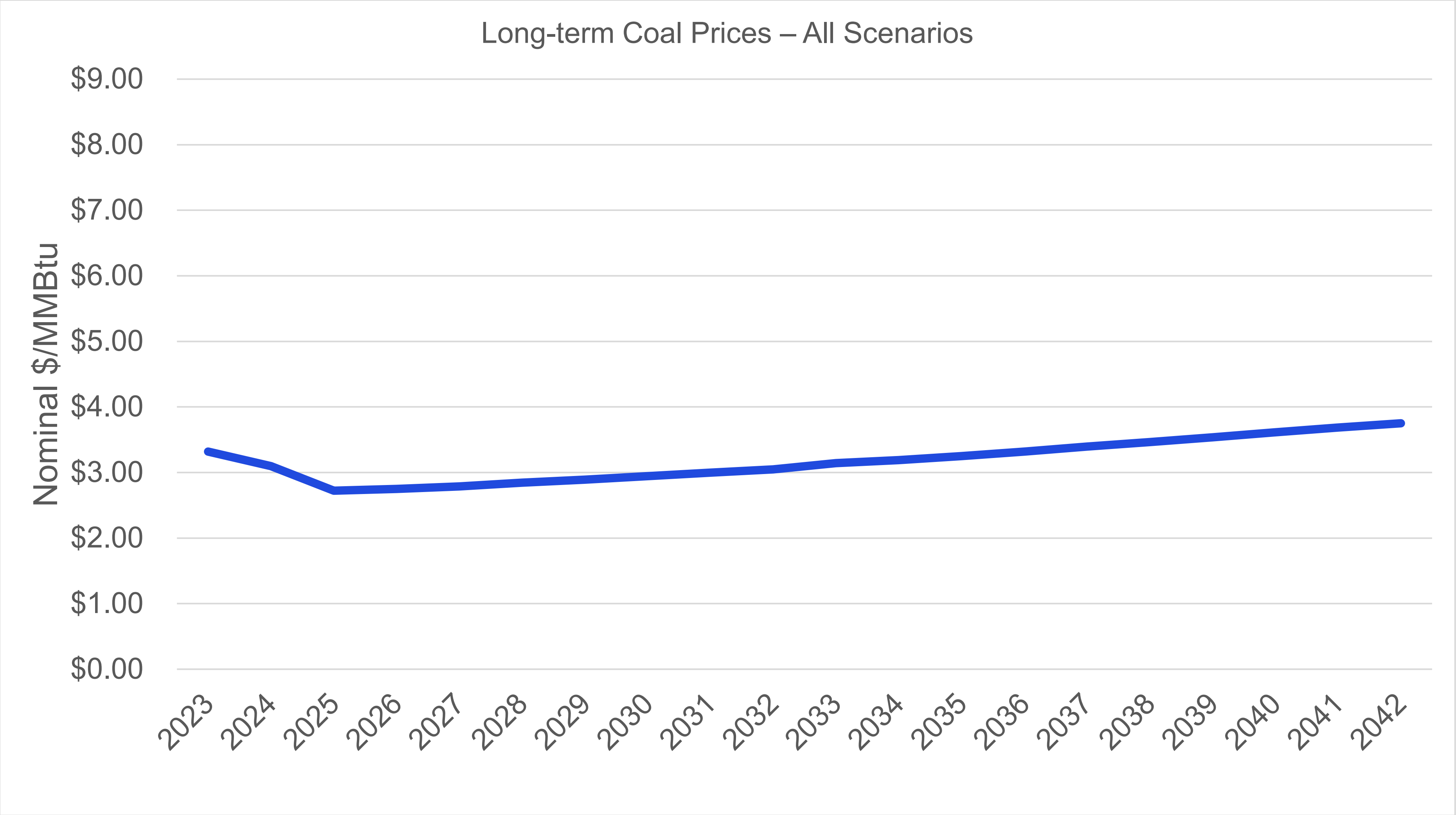
aes Indiana

Fuel Price Forecasts

Blended Long-term Coal Prices –

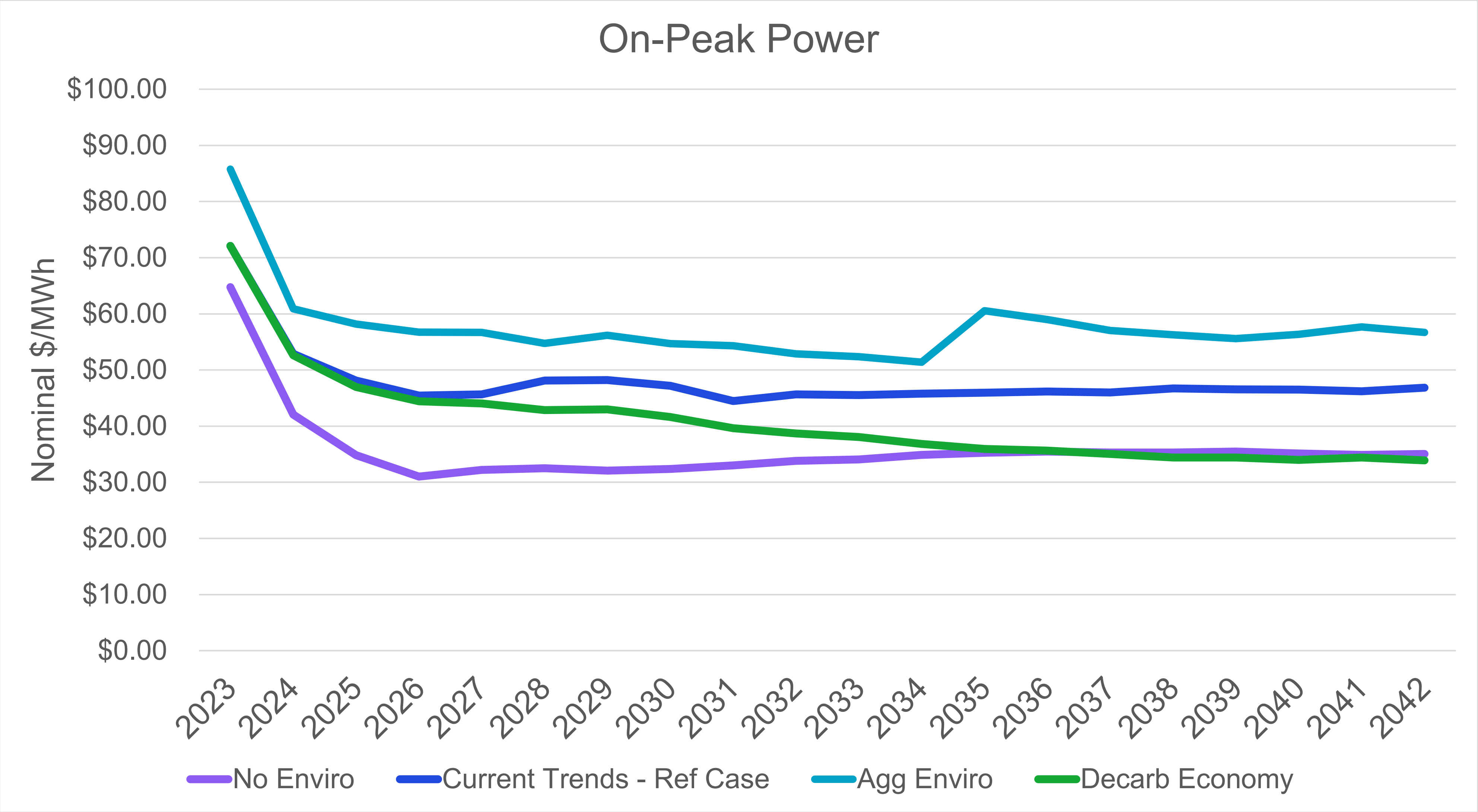
- 2023 – 2025 Blended: Internal Mkt Intelligence,
- 2026 – 2042: Internal Mkt Intelligence with Horizon Energy Spring Case growth rate for Illinois Basin

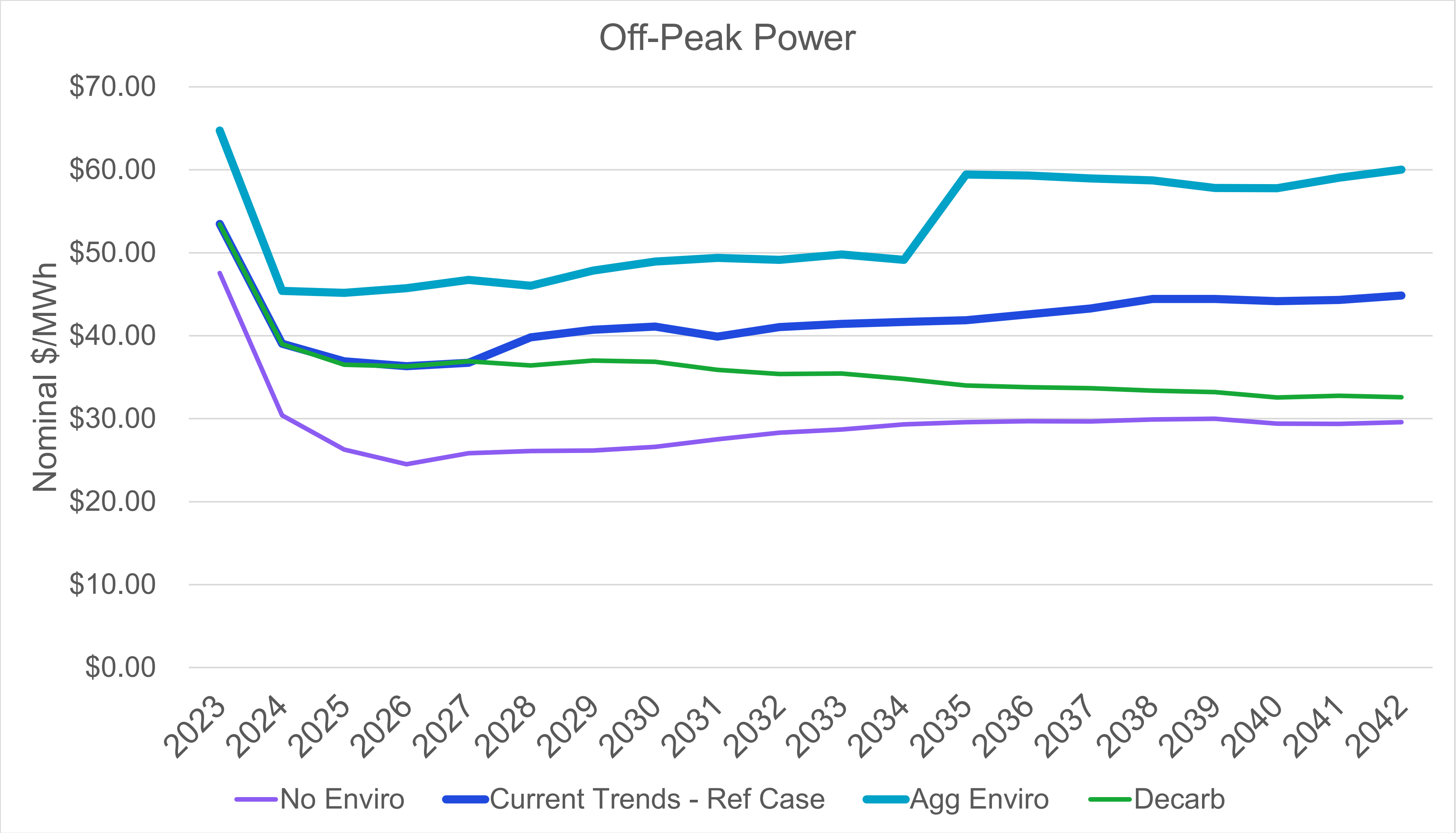




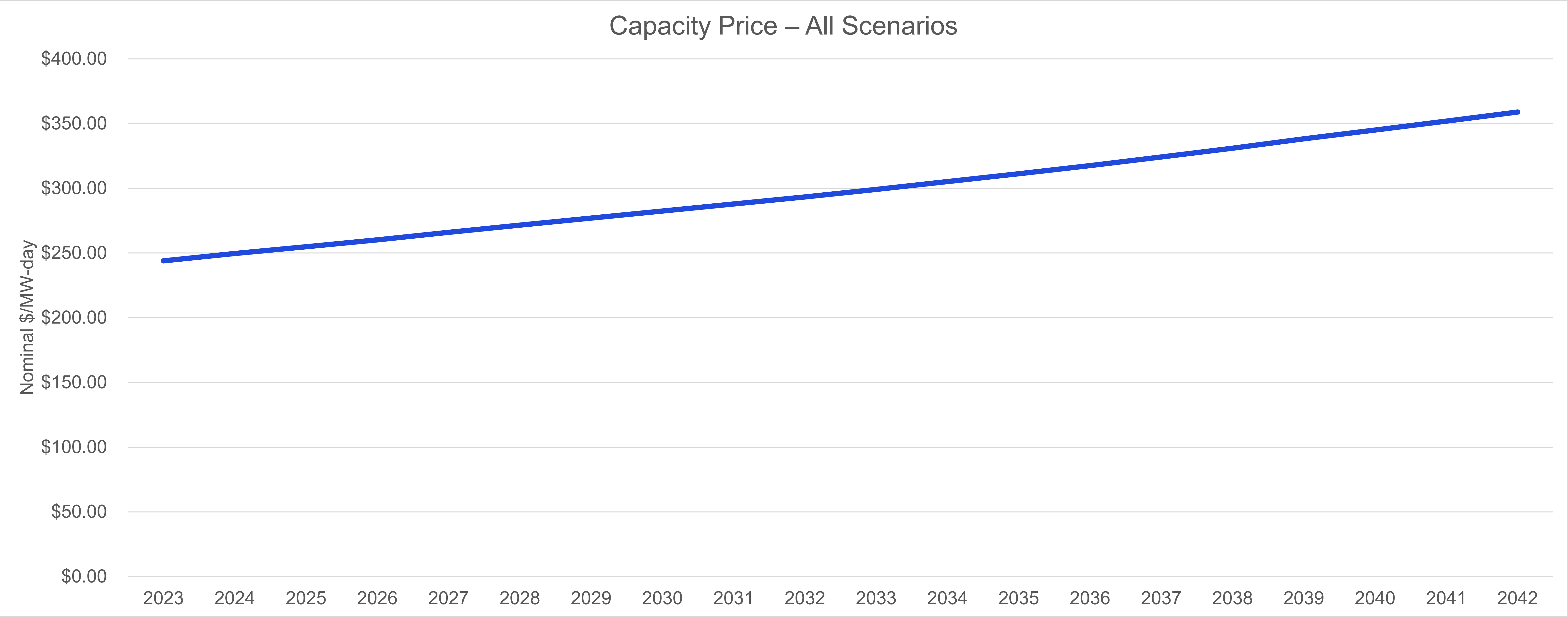
aes Indiana

Power Price Forecast



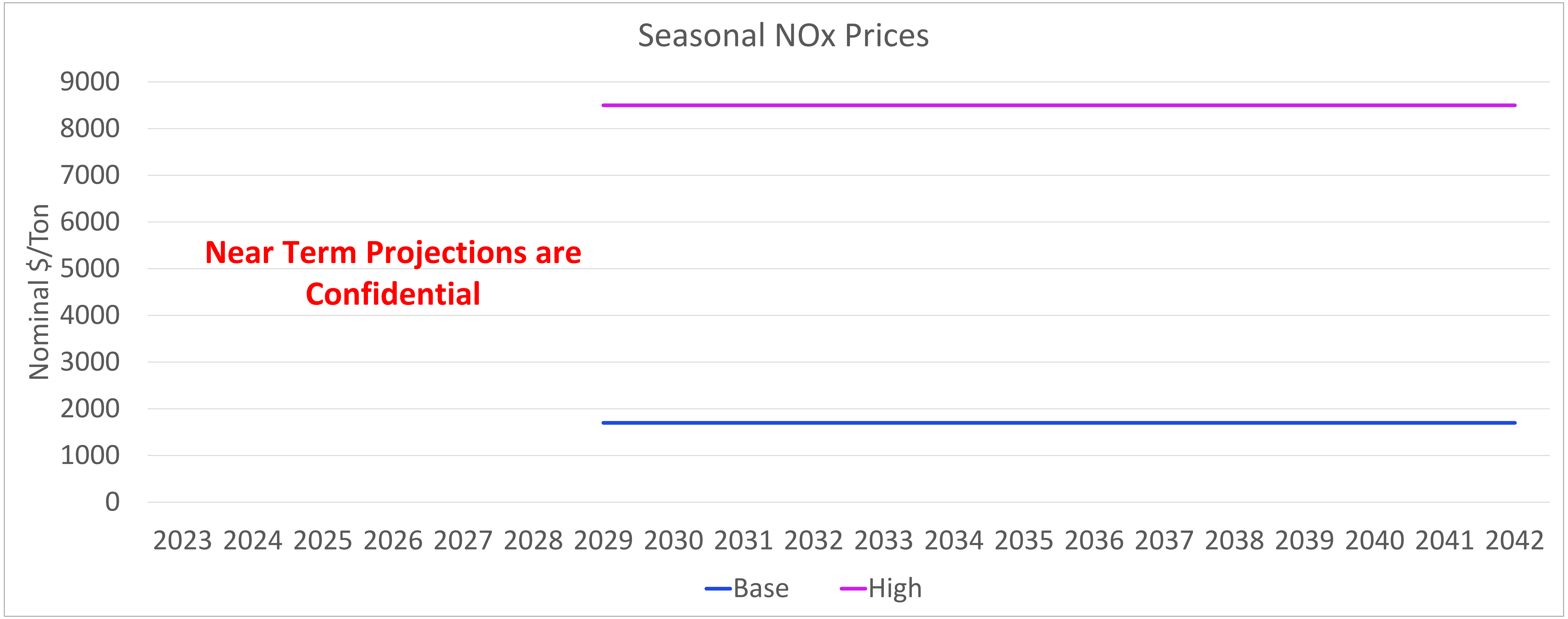


Capacity Price Forecast



aes Indiana

NOx Price Forecast



AES Indiana

RTO Reliability Planning: Resource Adequacy & Seasonal Construct

Lynn Hecker, Senior Manager, Resource Adequacy Policy and Analytics, MISO

Break for Lunch

Time	Topic	Speakers
Afternoon Starting at 12:30 PM	Modeling Reliability Assumptions	Erik Miller, Manager, Resource Planning, AES Indiana
	Reliability Analysis & Reliability Metric	Hisham Othman, VP Transmission and Regulatory Consulting, Quanta
	Portfolio Metrics & Scorecard	Erik Miller, Manager, Resource Planning, AES Indiana
	AES Indiana Distribution System Planning	Kathy Storm, Vice President, US Smart Grid, AES Indiana Mike Russ, Senior Manager, T&D Forecasting, AES Indiana
	Final Q&A and Next Steps	

Modeling Reliability Assumptions

Erik Miller, Manager, Resource Planning, AES Indiana

Reliability Overview

aes Indiana

The Importance of Measuring Reliability

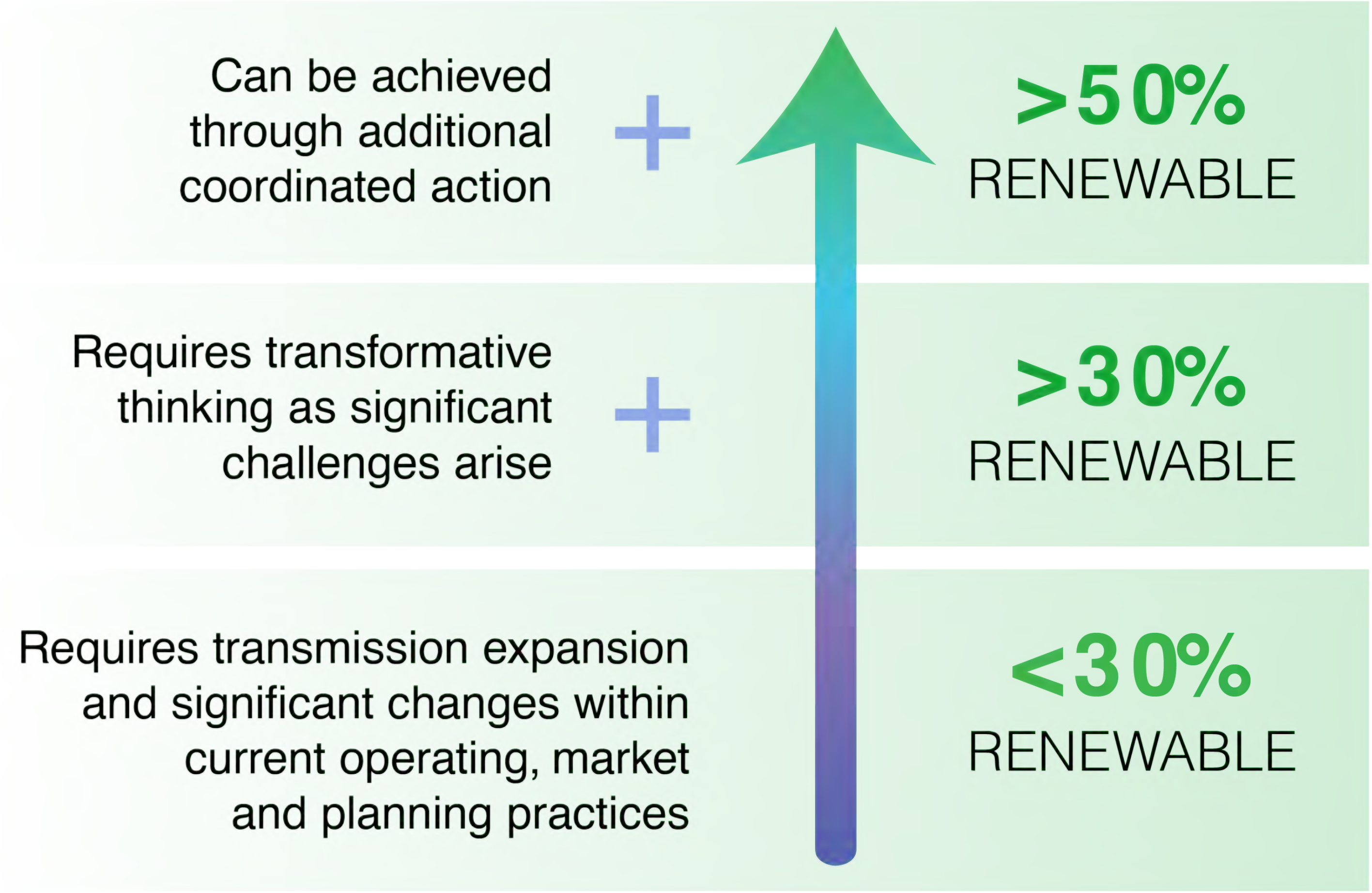
→ Guiding research on reliability

→ **MISO's Renewable Integration Impact Assessment (RIIA) – completed Feb 2021**

- MISO analysis to understand the bulk electric system needs and risks as intermittent renewable resources increasingly replace baseload resources.
- Analysis finds increasing risk and need for coordinated action as renewables increase to 30% and 50% of the MISO system portfolio.

→ **RIIA's three key areas of focus**

- The RIIA analysis suggests three key focus areas for MISO and stakeholders.
- **Utilities can consider two of the three within the context of the IRP.**



Topic	Definition	Planning Responsibility
Resource Adequacy	Having sufficient resources to reliably serve peak demand	AES Indiana will address in this IRP
2 **Energy Adequacy**	Ability to provide energy in all operating hours continuously throughout the year	AES Indiana will address in this IRP
3 **Operating Reliability**	Ability to withstand unanticipated component losses or disturbances	Joint coordination between AES Indiana and MISO

https://www.misoenergy.org/planning/policy-studies/Renewable-integration-impact-assessment/

Reliability in the IRP

1

MISO Seasonal Resource Adequacy Construct

- → On November 30, 2021 – MISO filed with FERC to include seasonal and accreditation requirements for the MISO Resource Adequacy Construct.
- → Reason: Ensure resource adequacy across all seasons after significant increase in MaxGen events resulting from the retirement of baseload generation, increased intermittent resources and extreme weather events.
- → MISO's proposed filing would require MISO member utilities to meet an unforced capacity requirement in each season as opposed to only Summer (current requirement).
- → MISO has proposed these changes begin in the 2023/2024 planning year.

Planning Implications

- → AES Indiana will model a four-season Resource Adequacy Construct starting in 2023/2024 to align with MISO's FERC filing.
- → Per MISO guidance, AES Indiana will include these reserve margin targets in the IRP analysis:

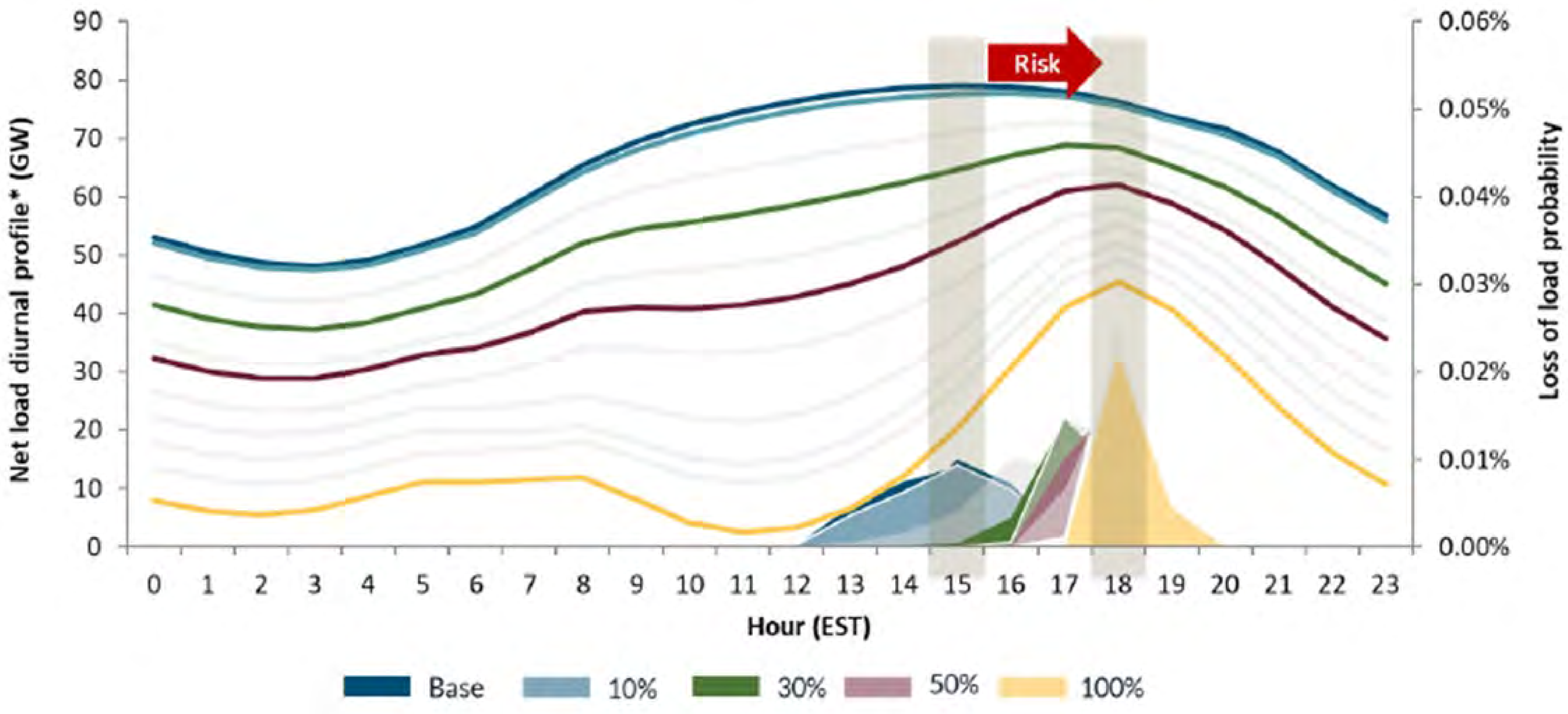
Target Seasonal Planning Reserve Margin:

PRM% Summer	7.51%
PRM% Fall	11.82%
PRM% Winter	21.35%
PRM% Spring	26.27%

aes Indiana

Reliability in the IRP

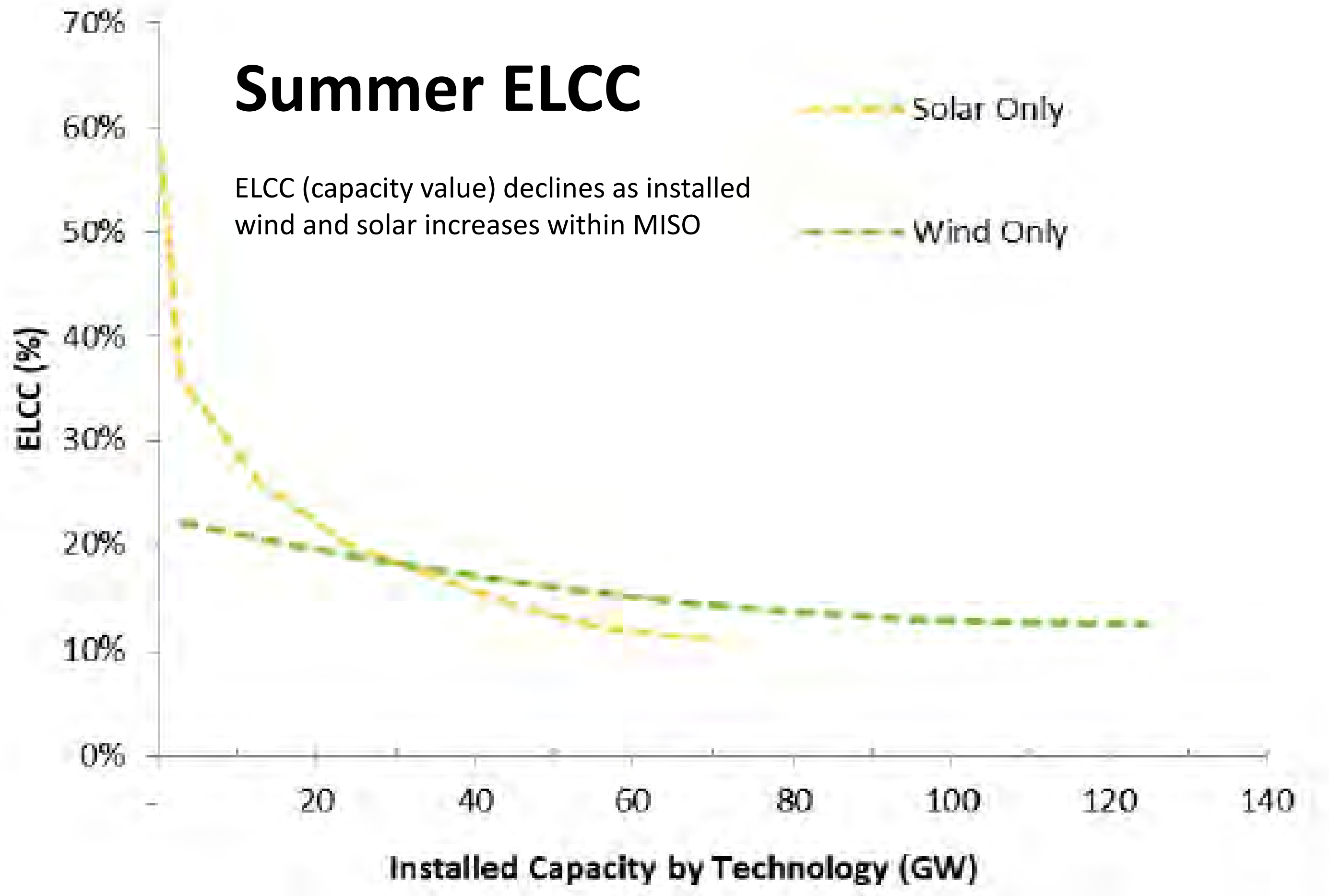
1 **Resource Adequacy:** Having sufficient resources to reliably serve load



*Charts from MISO RIIA Report pp.27 & 29

Planning Implications:

- The planning model will capture the changing availability of wind and solar through the ELCC, i.e. capacity value for wind and solar
- AES Indiana has consulted with MISO to understand the ELCC value for seasonal planning – Summer, Winter, Spring & Fall



****AES Indiana presented ELCC of wind, solar and storage resources in Public Stakeholder Meeting #2 – also provided in slide appendix of this deck****

aes Indiana

Reliability in the IRP

2

Production Cost Modeling (8,760)

- As part of the core IRP modeling, AES Indiana will perform a production cost analysis on each candidate portfolio.
- The analysis provides an understanding of economic energy adequacy or how much AES Indiana will rely on the market for sales and purchases.

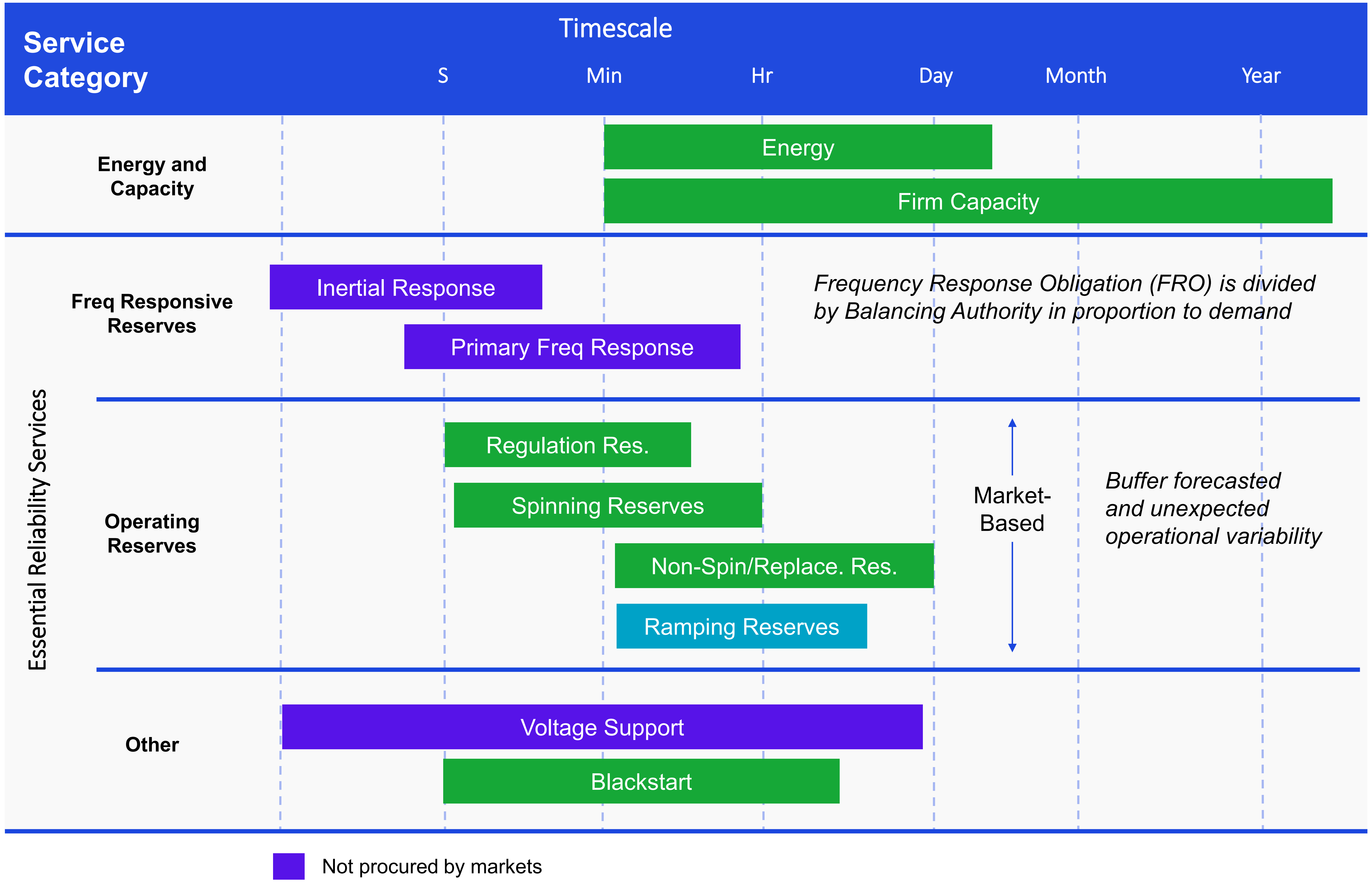
System Reliability Analysis

- AES Indiana contracted Quanta Energy to perform a System Reliability Analysis as part of the IRP Scorecard evaluation.
- The analysis looks at eight system metrics with the objective of evaluating how well the candidate portfolios deliver sufficient energy and system stability in every hour.
- **Quanta Energy will review the methodology for the System Reliability Analysis in the slides that follow.**

Reliability Analysis

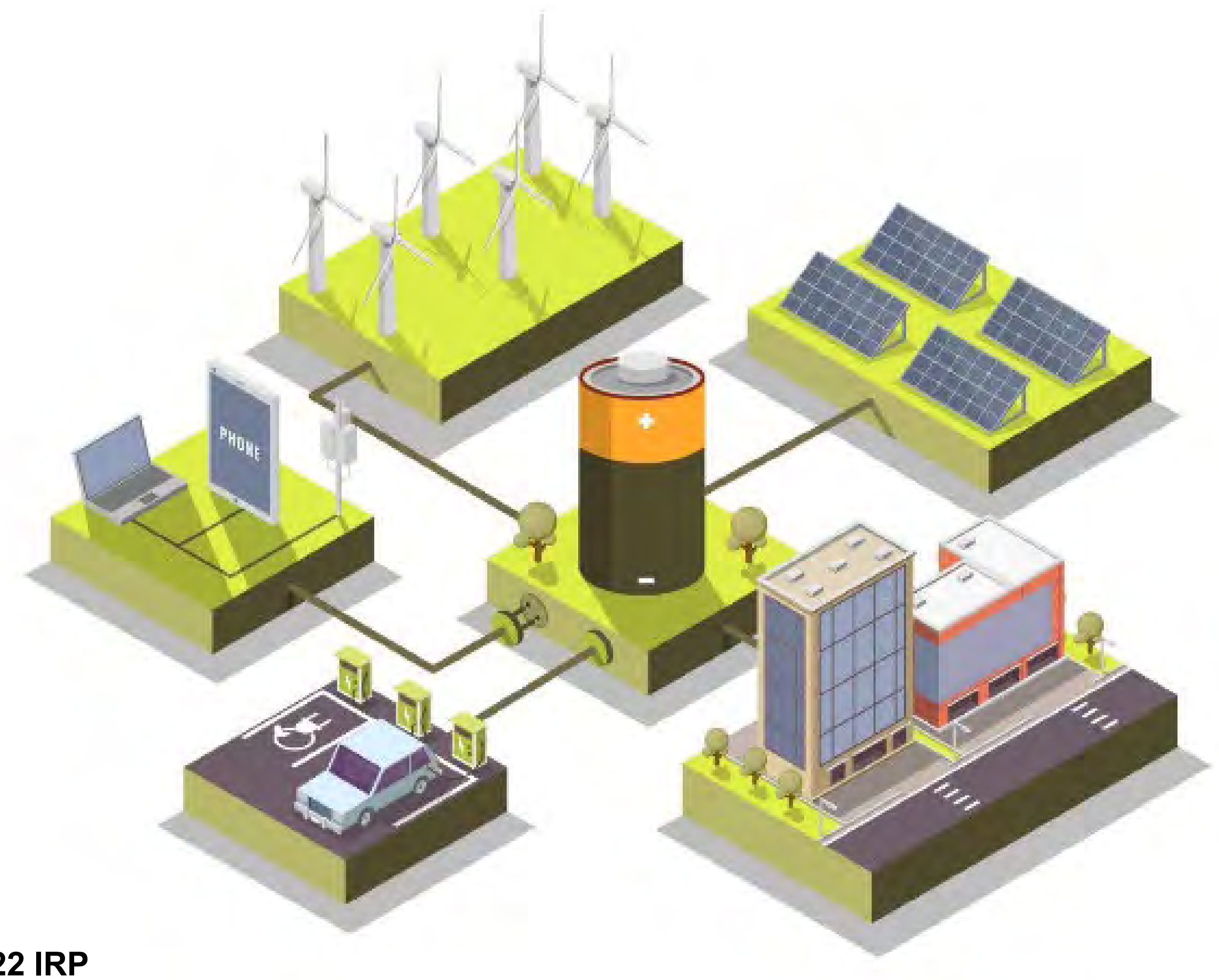
Hisham Othman, VP Transmission and Regulatory Consulting, Quanta

Essential Reliability Services



- Power systems rely on several reliability services to operate and deliver expected services. Some have traditionally been assumed to be provided by the supply resources, while others are procured by the market. As the resource portfolio changes, the associated essential reliability services should be assessed and secured.
- **NERC (2022 Summer Reliability Assessment – MISO):**
  - Midcontinent ISO (MISO) faces a capacity shortfall in its North and Central areas, resulting in high risk of energy emergencies during peak summer conditions.
  - More extreme temperatures, higher generation outages, or low wind conditions expose the MISO North and Central areas to higher risk of temporary operator-initiated load shedding to maintain system reliability.
- **PJM (Grid of the Future - May 2022):**
  - A proliferation of IBRs can significantly impact reactive control, stability, short-circuit current, inertia and frequency control – all critical dimensions of future grid planning.

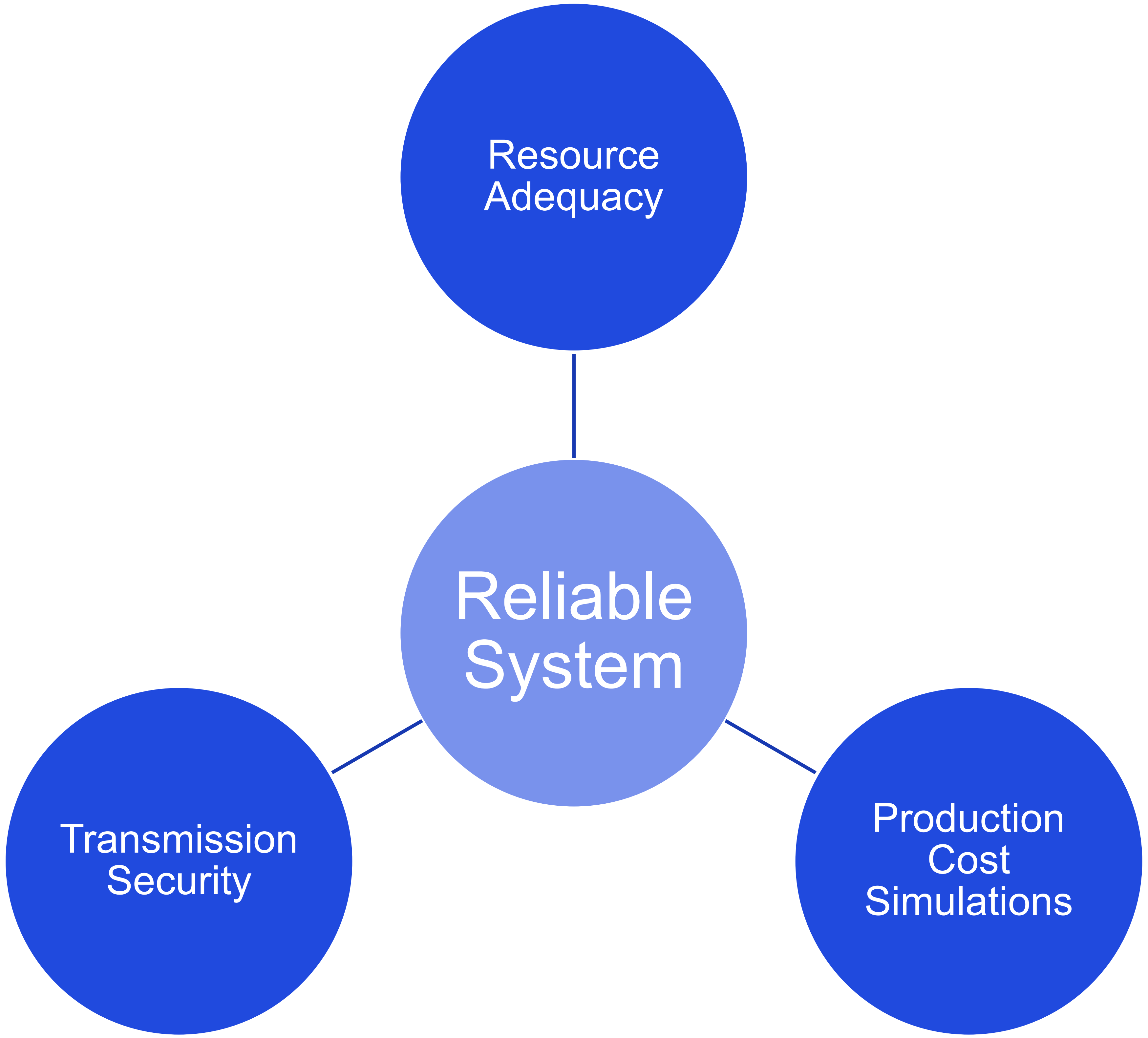
Resource Reliability Attributes



- **Reliability and Resilience Attributes/Metrics:**
  - Dispatchability
  - Predictability
  - Dependability (e.g., Supply Resilience, firmness)
  - Performance Duration Limits
  - Flexibility (e.g., ramping speed, operating range)
  - Intermittency (e.g., intra-hour and multi-hour ramping)
  - Dynamic VAR support
  - Energy Profile (e.g., capacity value / ELCC)
  - Inertial Response
  - Primary Frequency Response
  - Minimum Short Circuit Ratio
  - Locational Characteristics (e.g., deliverability, resilience to grid outages)
  - Blackstart and system restoration support
  - Harmonics

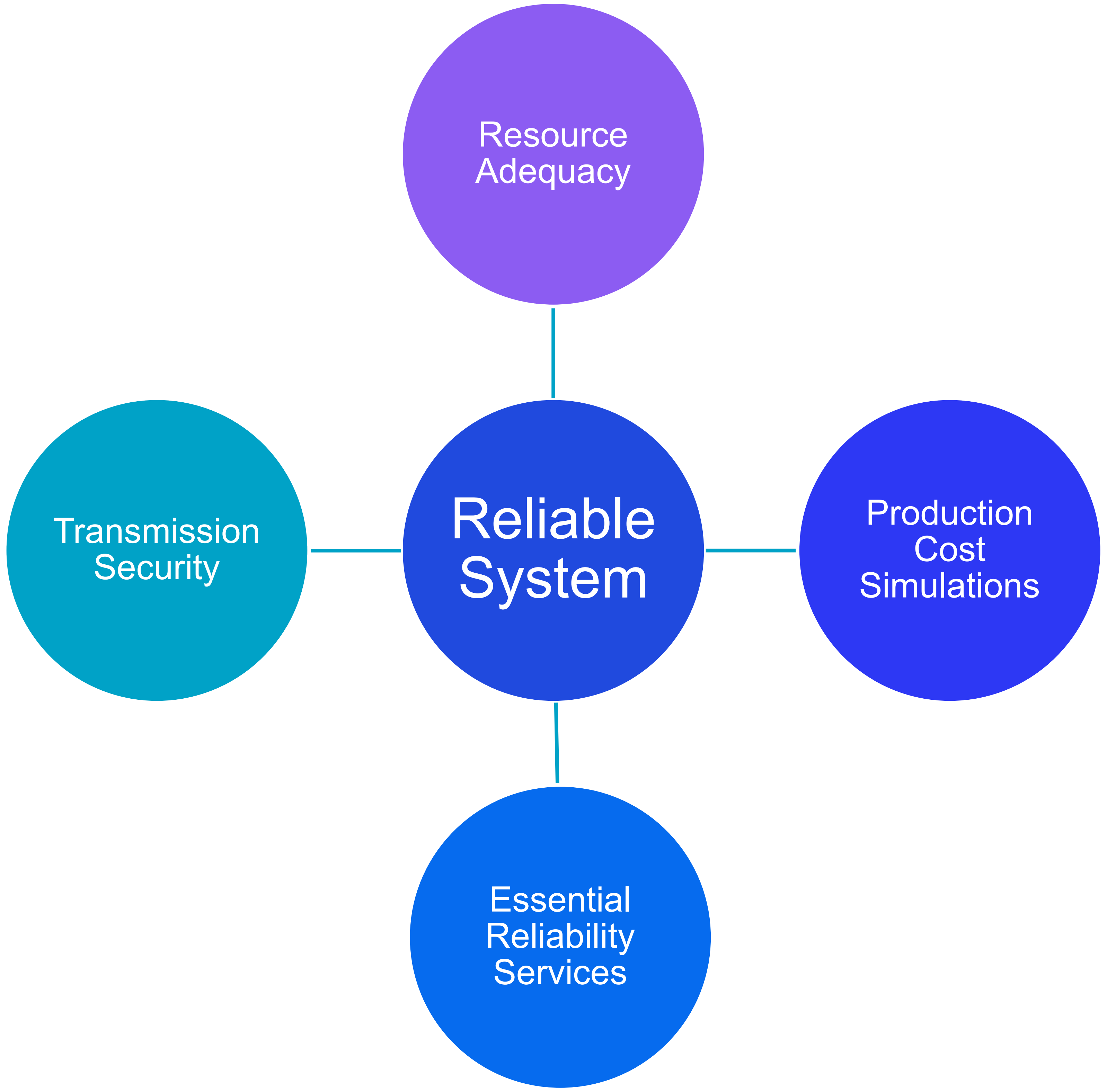
QUANTA TECHNOLOGY aes Indiana

Assuring System Reliability – Traditional Approach



QUANTA TECHNOLOGY aes Indiana

Assuring System Reliability – Evolving Approaches



Reliability Assessment & Portfolio Eval. Methodology

Review & Update Reliability Metrics

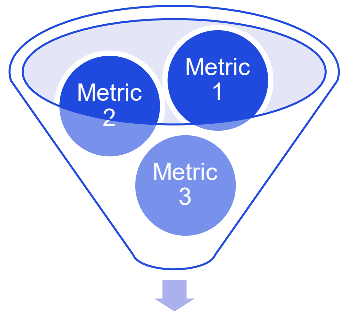
Assemble Data and Configure Analysis Tools

- Existing Resources
- IRP Portfolios
- Grid Models
- Solar & Wind Profiles
- Load Profile
- Transfer Capability with Outside

Apply a Series of Reliability Filters to IRP Portfolios

Design Scoring Criteria

Evaluate Portfolios



Portfolio Score

Indicative Scope of 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
2	Operational Flexibility and Frequency Support	X		X
3	Short Circuit Strength Requirement	X		X
4	Power Quality (Flicker)	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		

→ Additional Reliability Analysis

QUANTA TECHNOLOGY aes Indiana

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 that 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

QUANTA TECHNOLOGY

aes Indiana

Reliability Metrics (2/2)

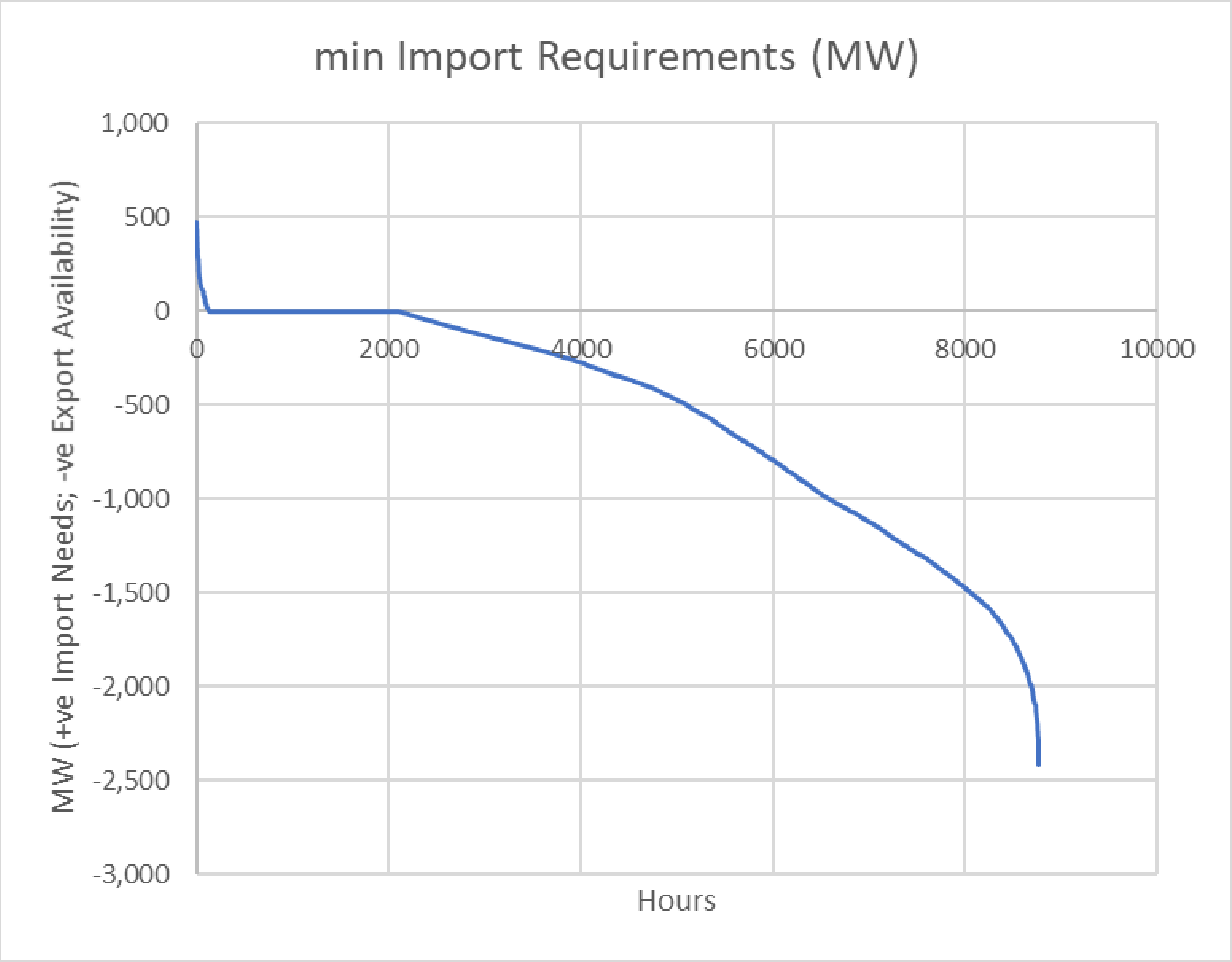
	Metric	Description	Rationale
7	**Dispatchability and Automatic Generation Control**	Resources should respond to directives from system operators regarding their status, output, and timing. Resources that can be ramped up and down automatically to respond immediately to changes in the system contribute 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.

Sample Analysis

The following are illustrative sample analyses, not related to AES-Indiana system or portfolios.

(1) Energy Adequacy during Market Emergency Events

Illustrative sample analyses, not related to AES-Indiana system or portfolios



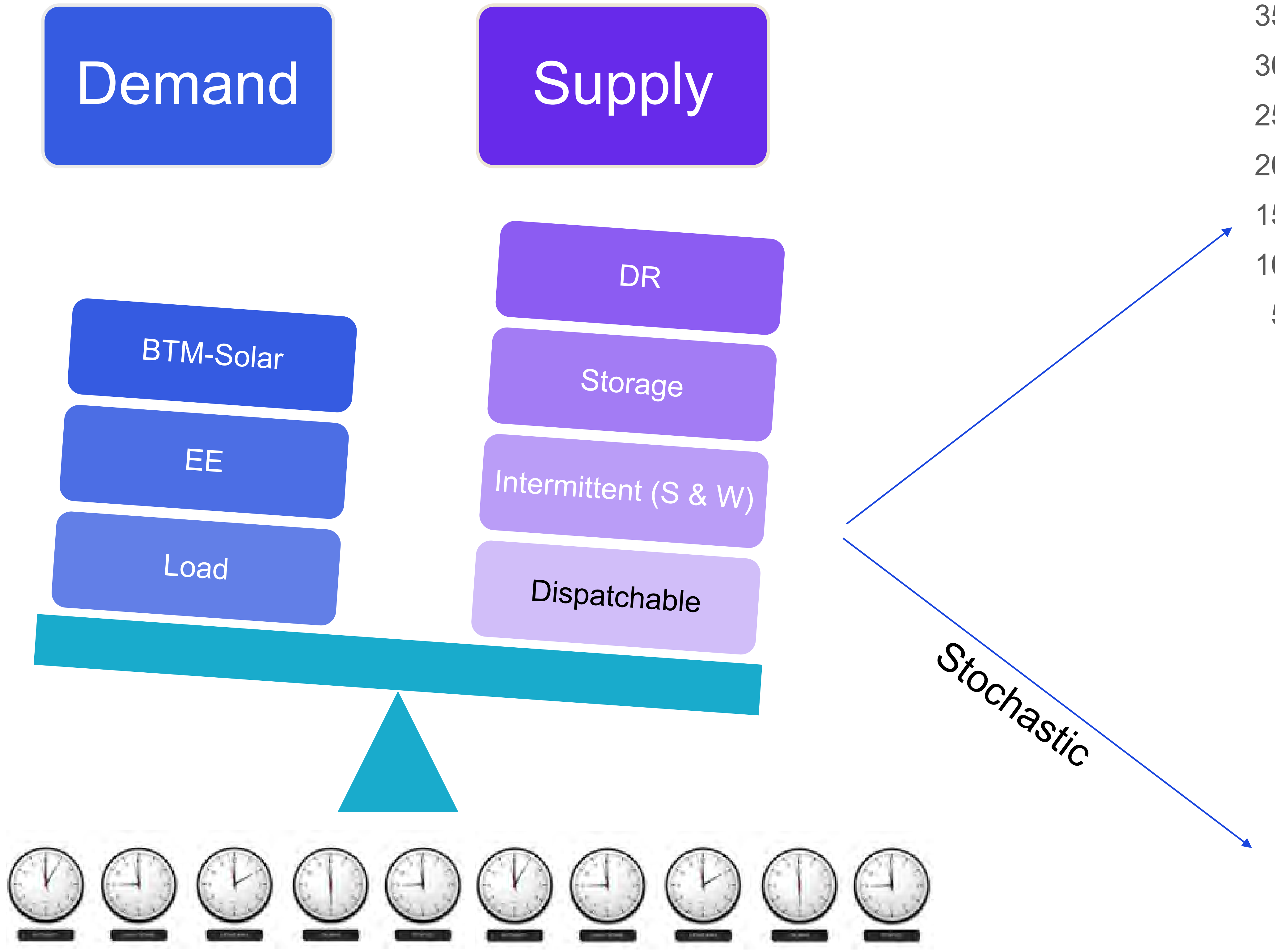
# Import Hrs	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	2	0	0
7	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	15	17	10	6	2
8	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3	17	17	6	2	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	7	3	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

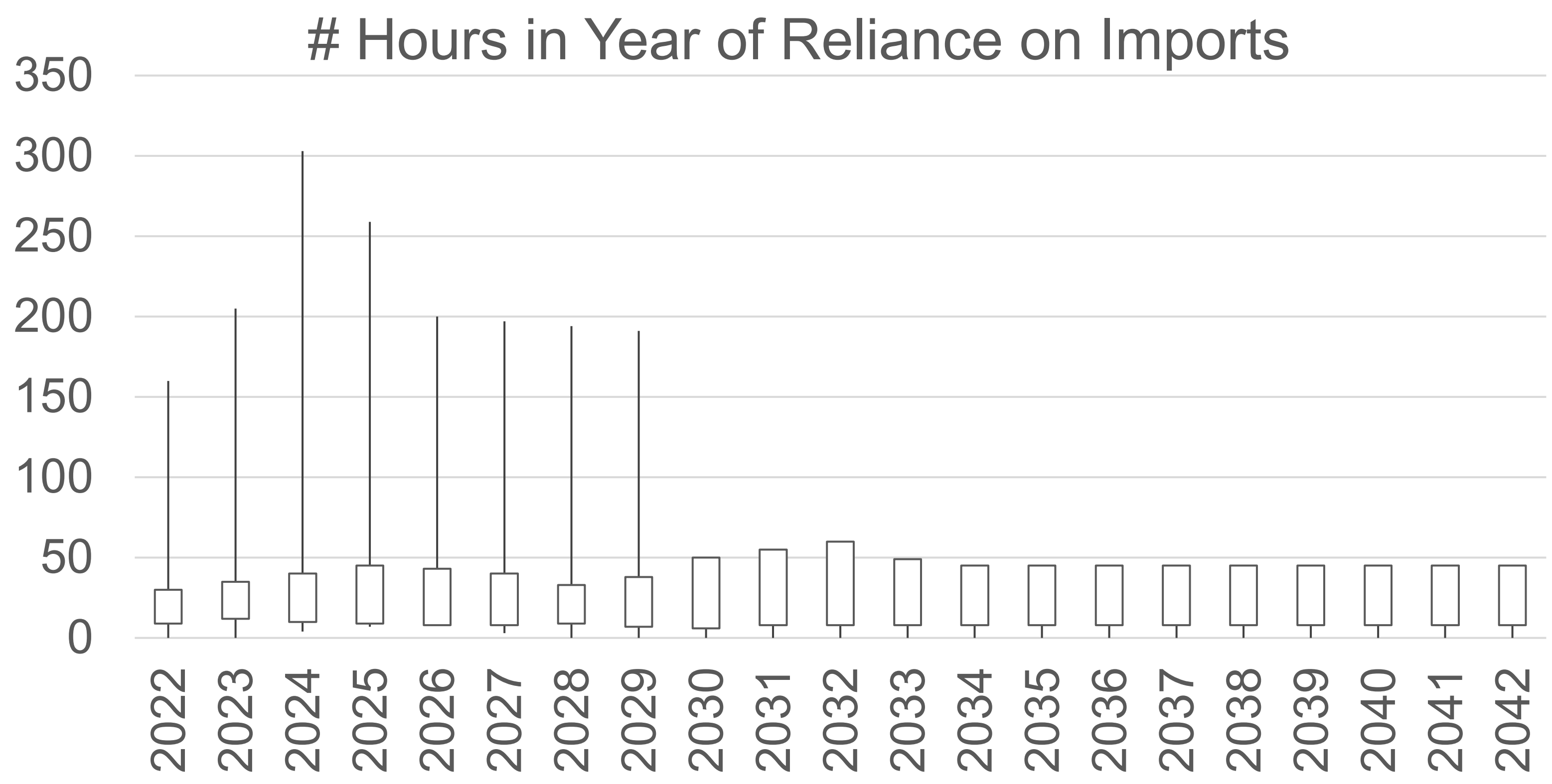
→ The analysis shows that a sample Portfolio P1 is energy long and relies on energy purchases only 136 hours in a year (i.e., 2% of time) to meet its energy needs with a maximum purchase of 475MW, while it has excess energy to potentially sell 6,658 hours in a year (i.e., 76% of time).

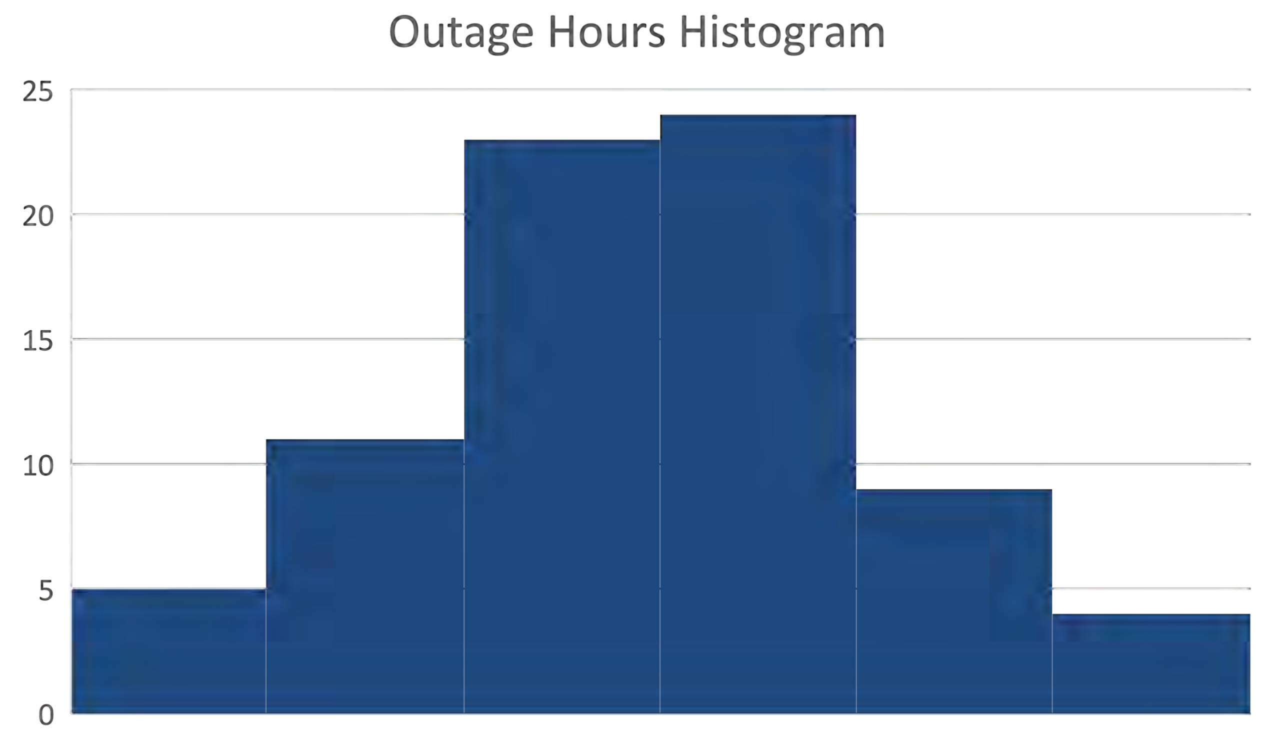
QUANTA TECHNOLOGY aes Indiana

(1) Energy Adequacy – Scenario & Stochastic Study Approaches

Illustrative sample analyses, not related to AES-Indiana system or portfolios







QUANTA TECHNOLOGY aes Indiana

(3) Importance and Impacts of Short Circuit Strength

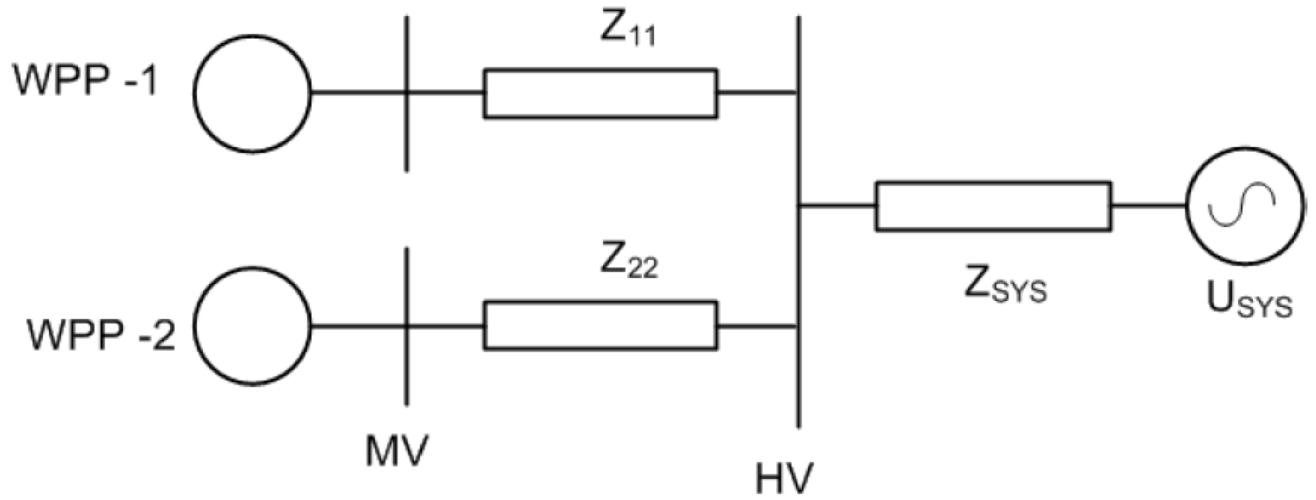
Illustrative sample analyses, not related to AES-Indiana system or portfolios

Impact:

- When conventional power plants with synchronous generators are retired and/or the system tie-lines are severed, the short circuit currents will dramatically decline. IBRs are not a substitute because their short circuit contribution is limited, and also the phase of their current (real) is not aligned with typical short circuit currents (reactive).
- Declining SCMVA and increasing IBRs will eventually violate the ESCR limits, requiring either a prohibition on additional IBR interconnections, or provisioning additional mitigation measures.
- Mitigations can come in the form of optimal placement of IBRs to avoid clustering them in a manner that violates the ESCR limits, provisioning synchronous condensers, or requiring inverters to have grid-forming (GFM) capability.

(3) Short Circuit Strength: Equivalent Short Circuit Ratio

Illustrative sample analyses, not related to AES-Indiana system or portfolios



Bus #	IBR* (MW)	SCMVA	SCR	ESCR	ESCR with SC
237	30	343	11.5	2.1	3.2
59200	32	369	11.5	2.3	3.7
59100	32	600	18.7	2.5	4.0
238	23	206	8.9	2.2	4.2
1813	10	605	60.0	2.6	4.2
99000	20	481	24.0	2.6	4.2
119	29	311	10.8	3.0	4.2
56	29	343	12.0	2.2	4.3
94	28	1092	39.0	2.7	4.6
59400	23	736	32.0	3.1	4.8
2803	28	548	19.8	3.0	4.9

SCR is not a good indicator under high IBR penetration
Synchronous Condensers (SC) can increase short circuit strength

Optimal Placement of IBRs* from Short Circuit perspective to avoid ESCR limitation:

$$MAXIMIZE \ \sum_{j \in buses} P_j$$

Subject to $\sum_j IF_{ji} * P_j \leq \frac{S_i}{ESCR\ Threshold}$

$$P_j \geq 0$$

*Inverter Based Resource (IBR)

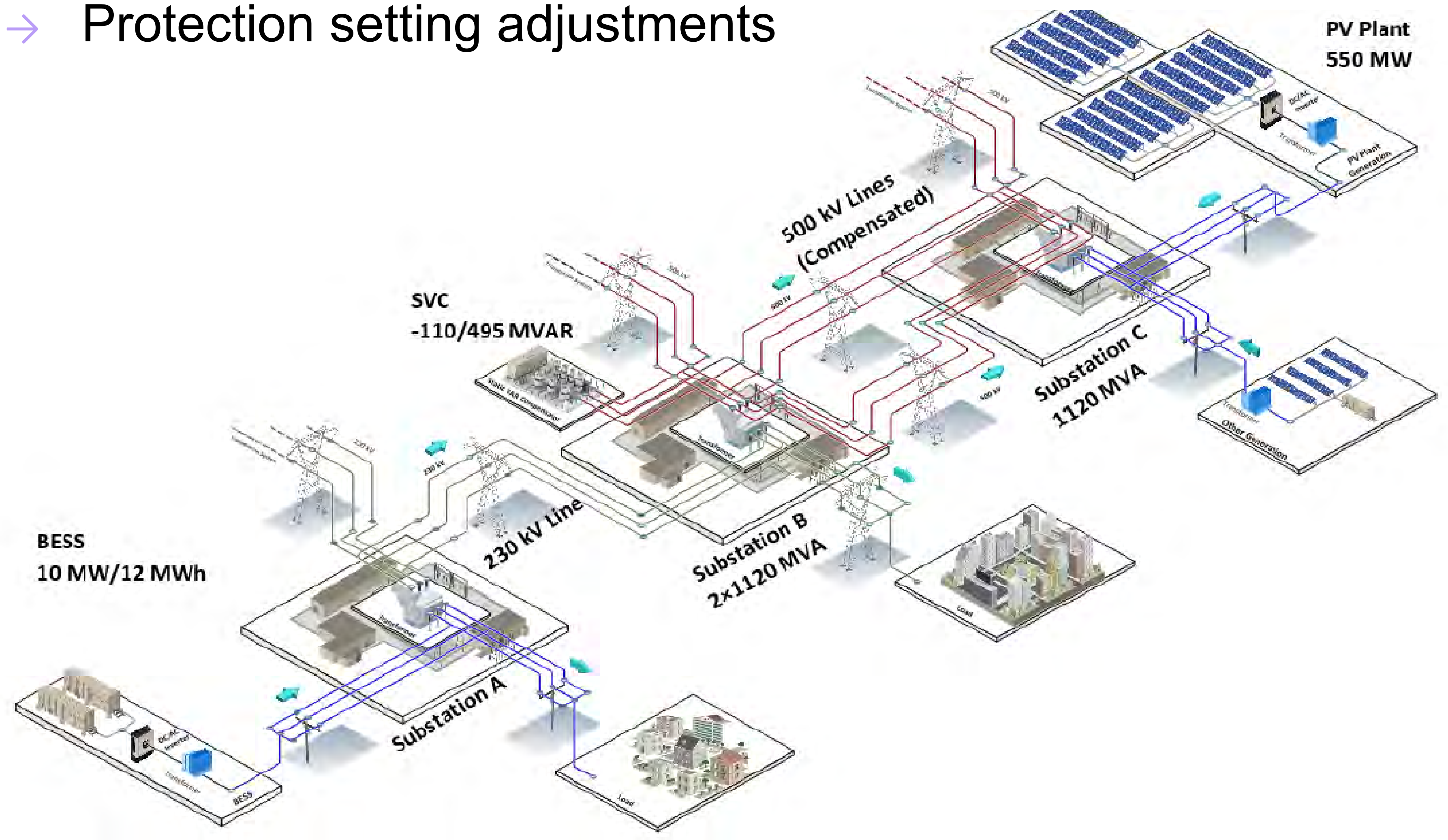
QUANTA TECHNOLOGY aes Indiana

(5) Black Start Studies – Key Considerations

Illustrative sample analyses, not related to AES-Indiana system or portfolios

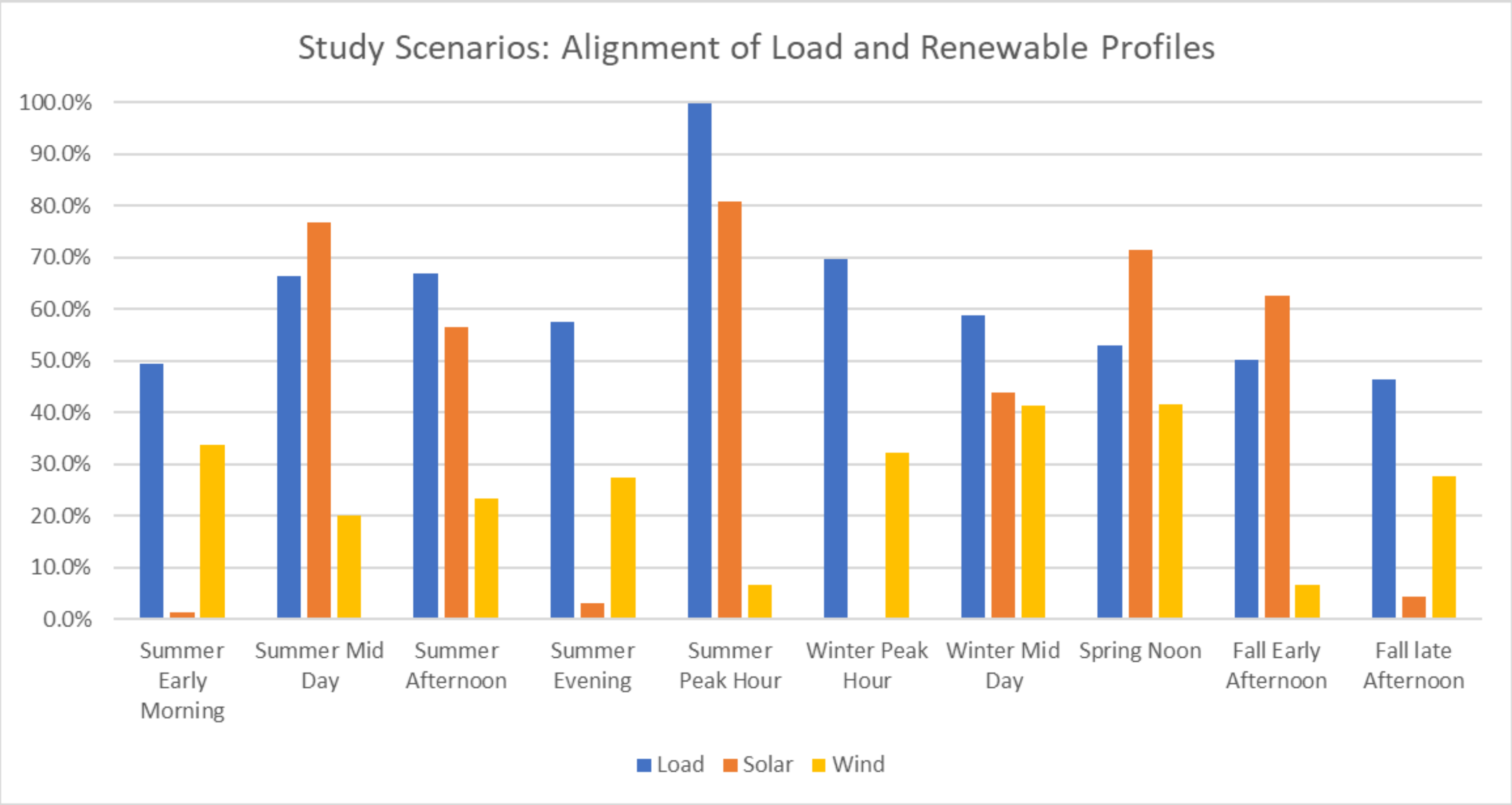
Results:

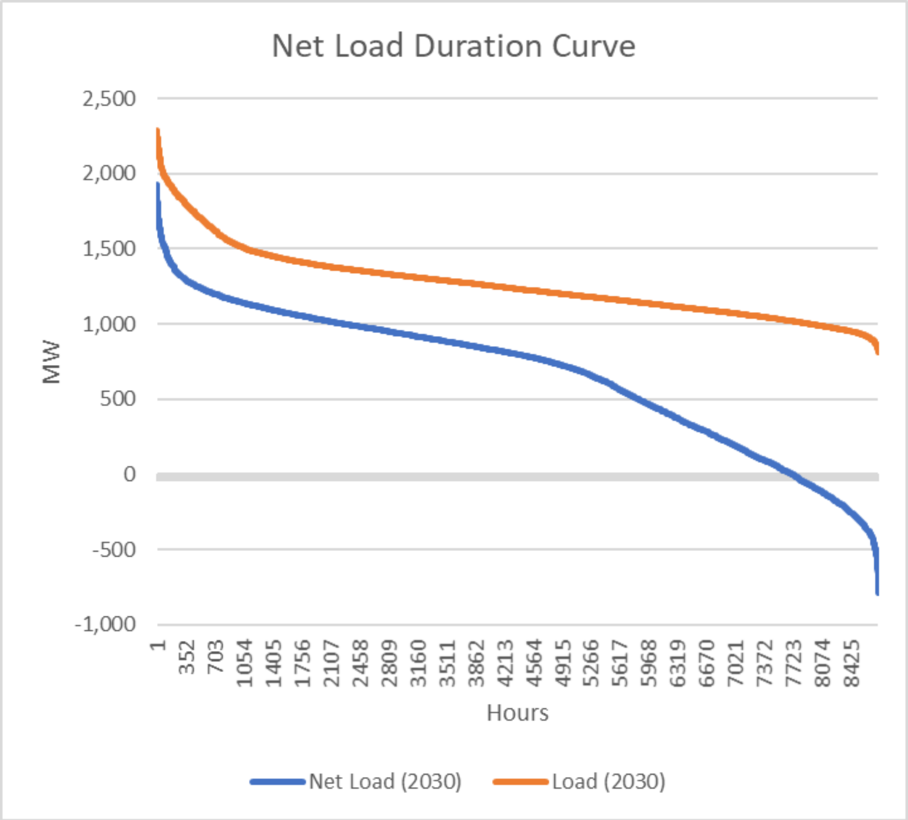
- Inverter Size (MVA, PF)
- BESS Size (MW, MWh)
- BESS control and protection settings
- Transformer tap settings
- Protection setting adjustments

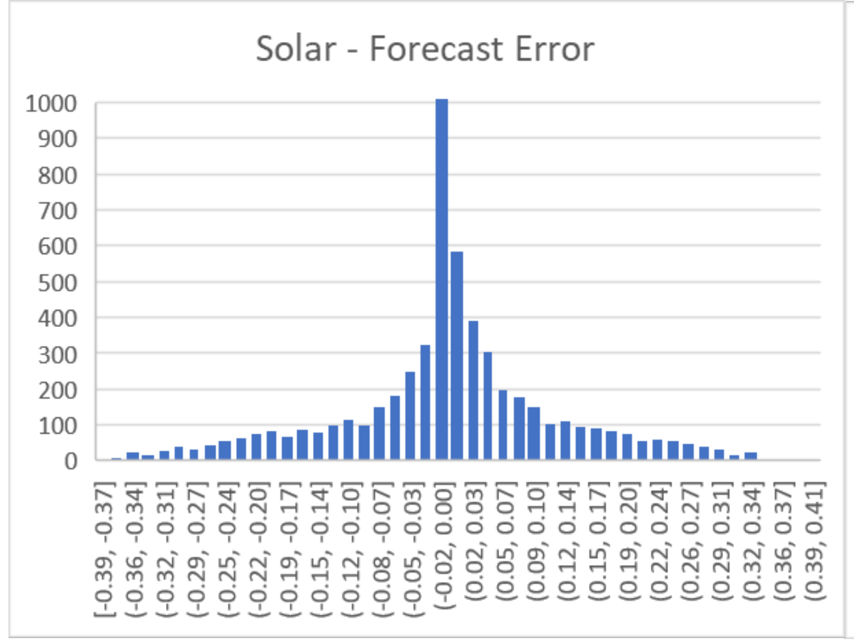


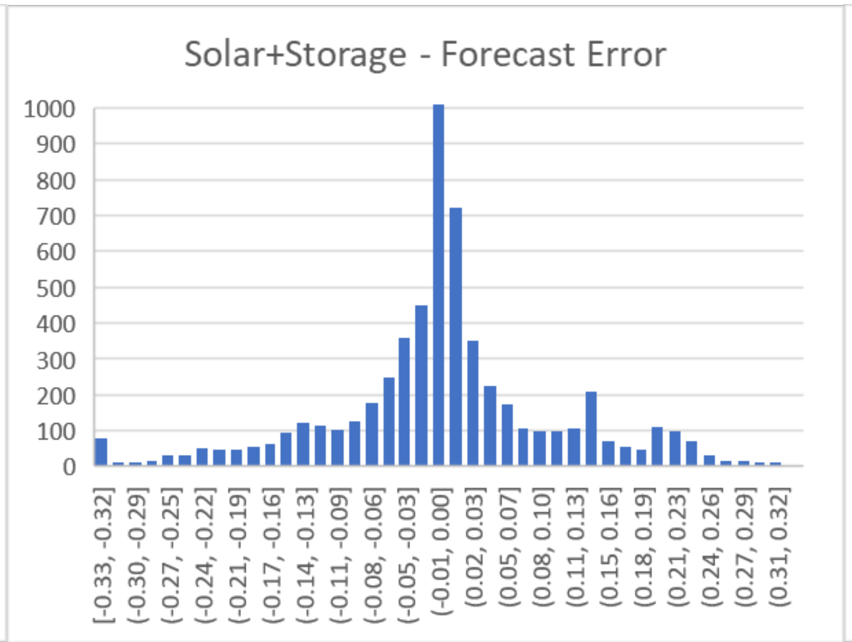
(8) Resource Predictability & Firmness: Variability Analysis

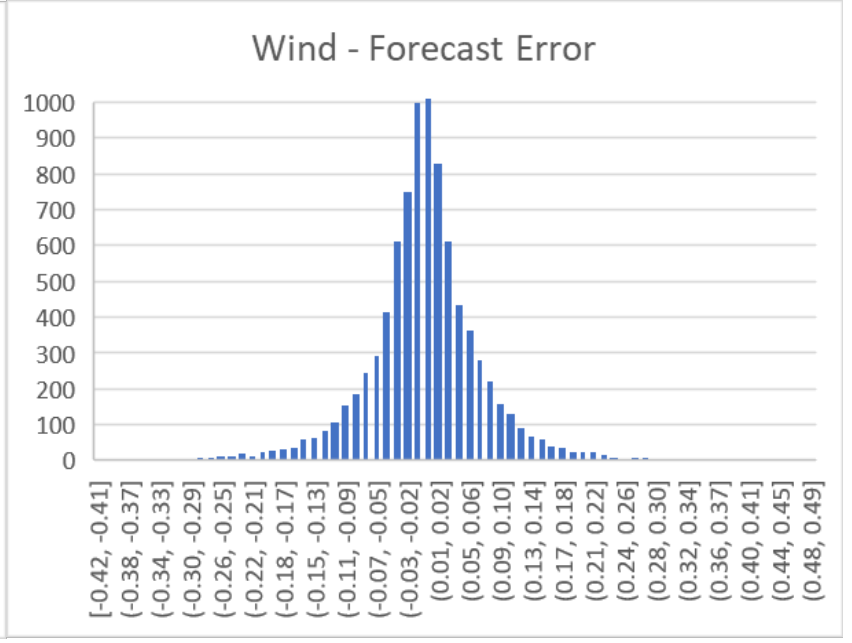
Illustrative sample analyses, not related to AES-Indiana system or portfolios









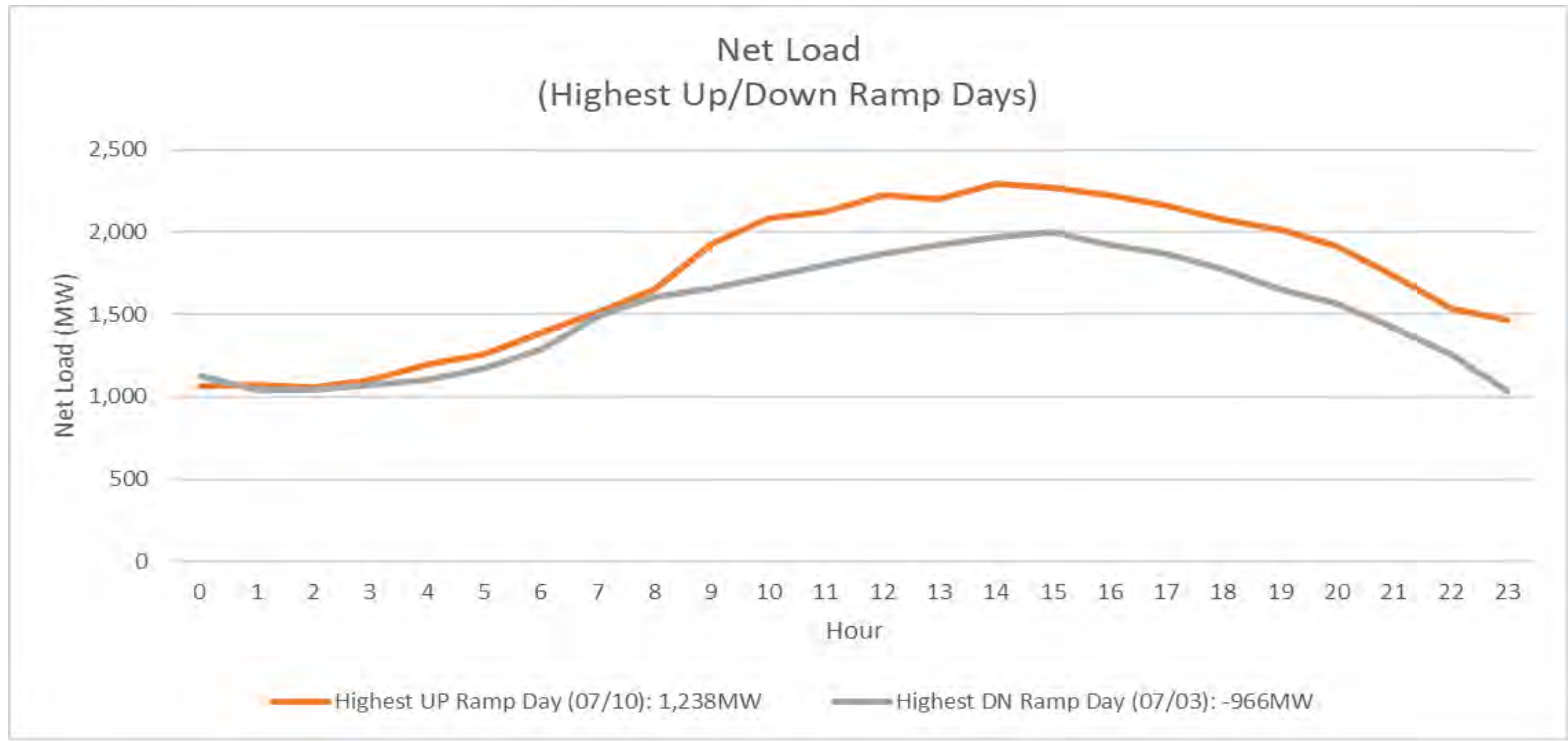


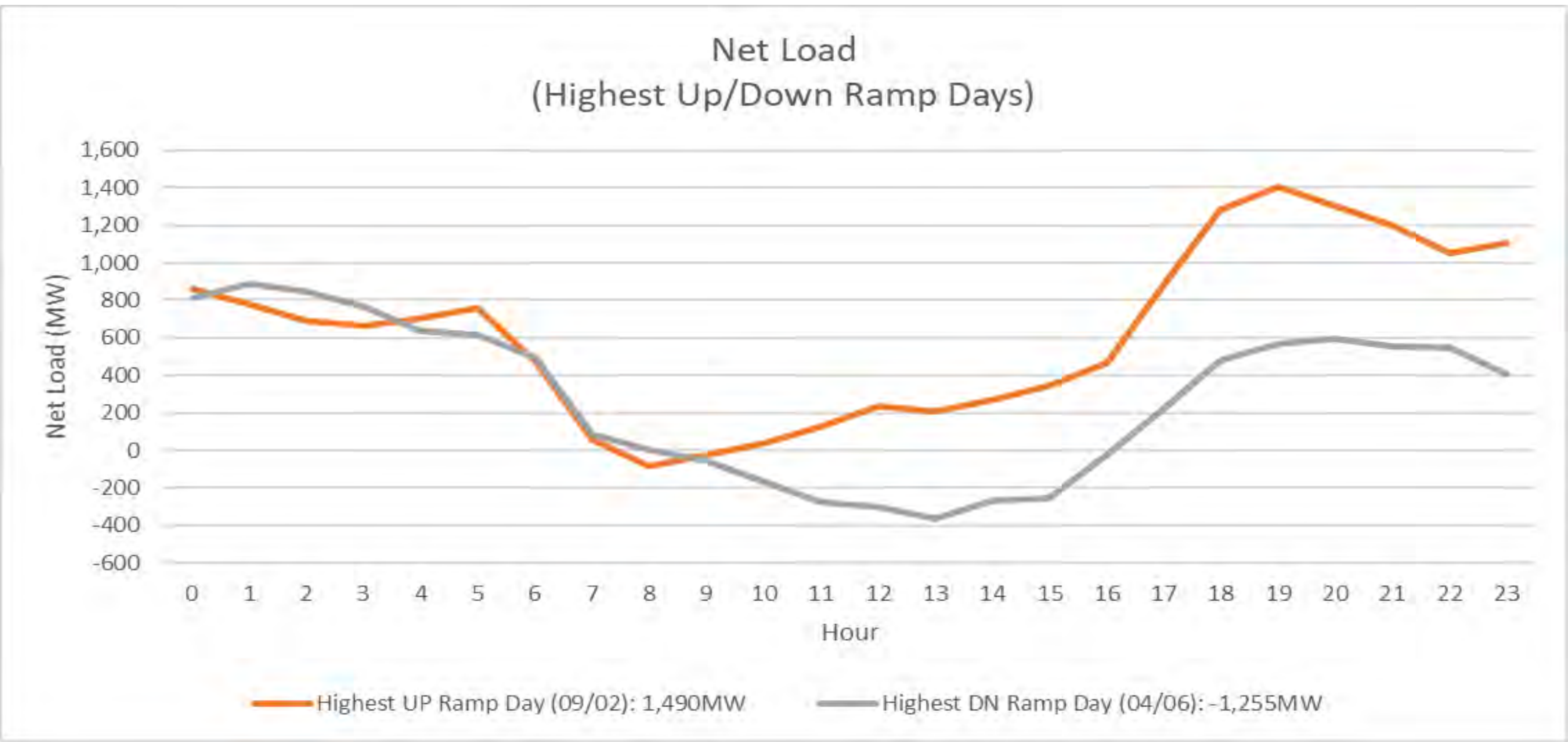
Forecast Error%	Solar	Wind	S+S
Standard Deviation	9.9%	7.5%	9.2%
min Error	-39%	-42%	-33%
max Error	39%	48%	33%
90% Percentile	19%	8%	12%

(8) Resource Predictability & Firmness: Net Load Power Ramps

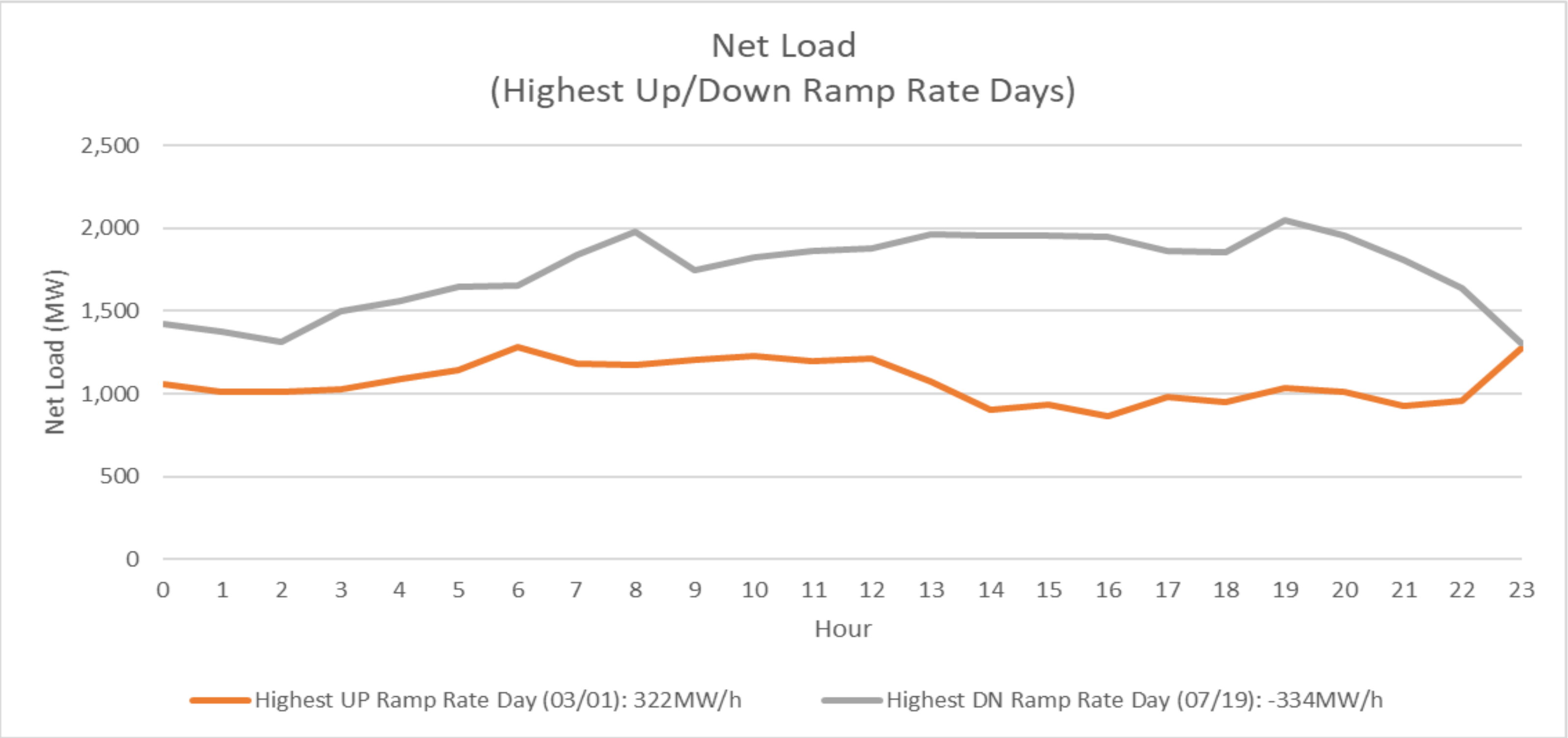
Illustrative sample analyses, not related to AES-Indiana system or portfolios

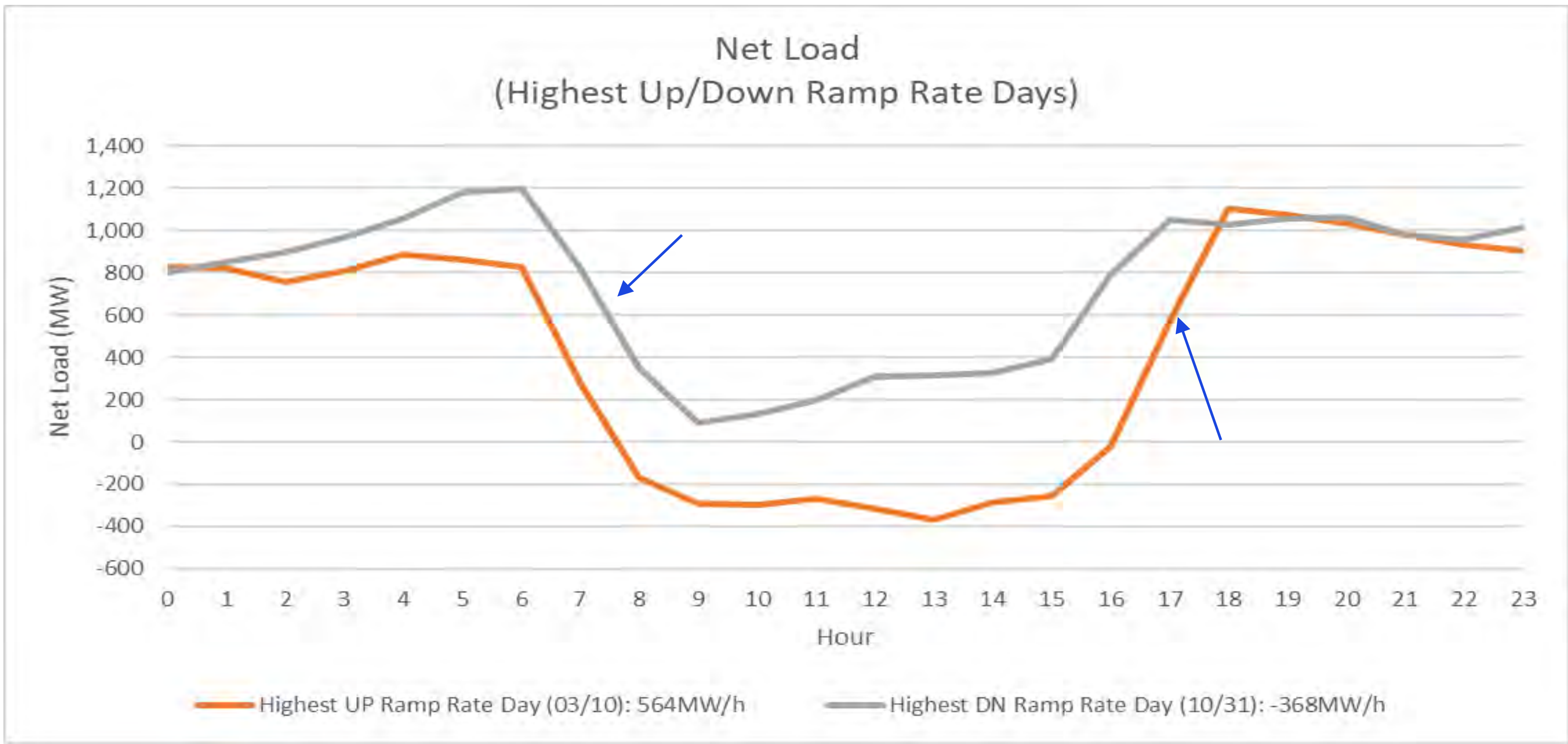
- Highest Up/Down Ramp Days





- Highest Up/Down Ramp Rate Hours





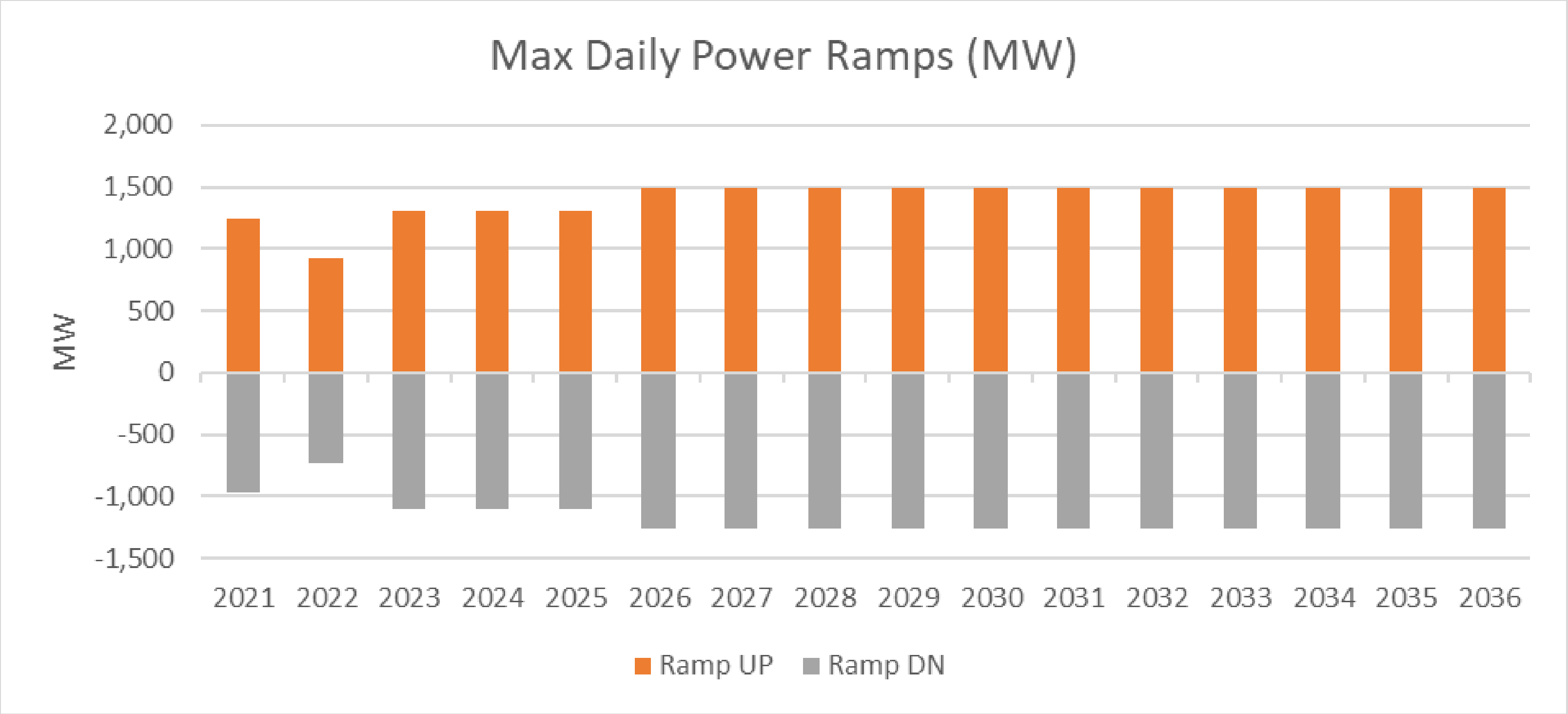
- Significant change in Net Load profile from a conventional shape in 2020 to a “Duck Curve” in 2030

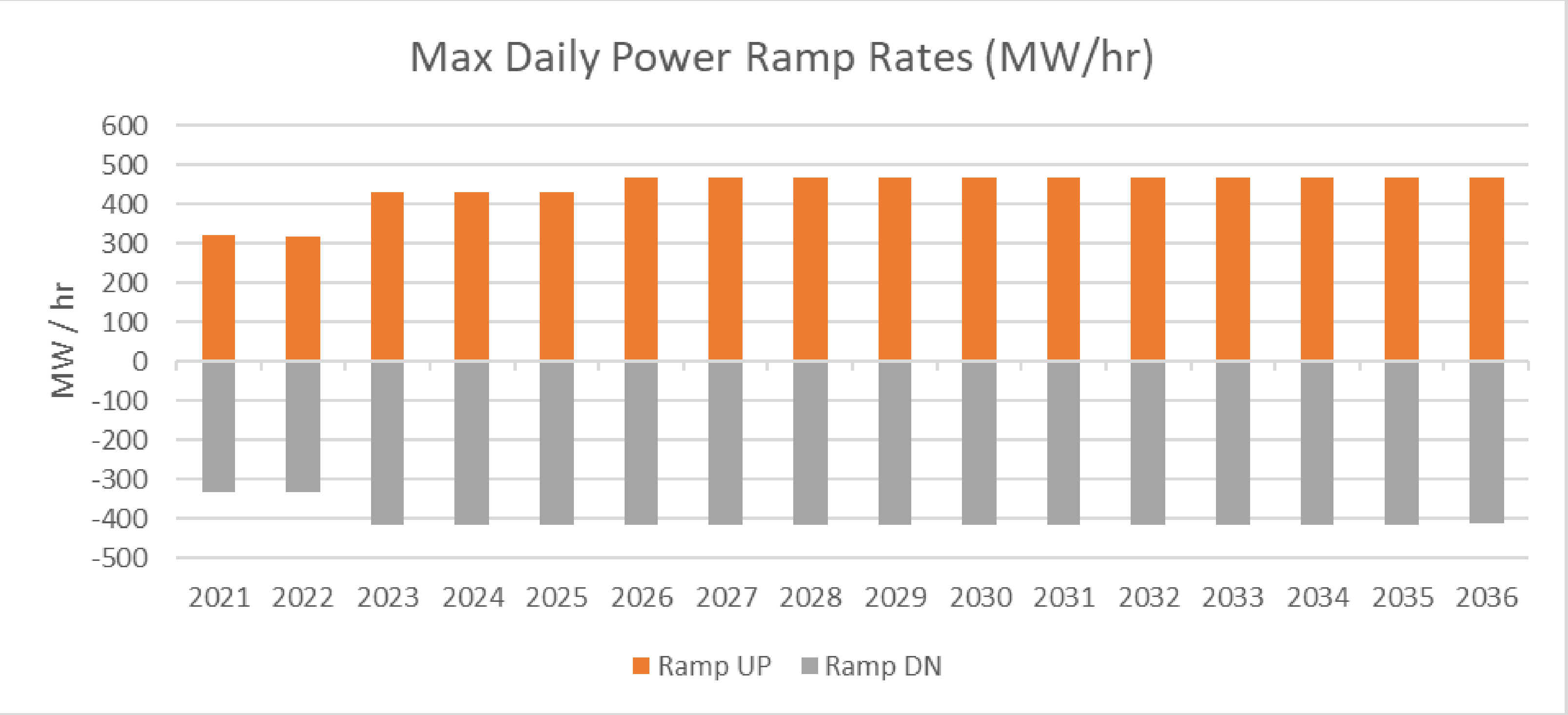
(8) Resource Predictability & Firmness: Net Load Power Ramps

Illustrative sample analyses, not related to AES-Indiana system or portfolios

Year	Ramp UP	Ramp DN	Ramp Rate UP	Ramp Rate DN
2021	1,238	-966	322	-334
2022	929	-733	319	-332
2023	1,309	-1,101	431	-415
2024	1,308	-1,101	430	-414
2025	1,307	-1,101	430	-414
2026	1,490	-1,255	468	-414
2027	1,490	-1,255	468	-414
2028	1,490	-1,255	468	-414
2029	1,490	-1,255	468	-414
2030	1,490	-1,255	468	-413
2031	1,489	-1,255	467	-413
2032	1,489	-1,255	467	-413
2033	1,489	-1,255	467	-413
2034	1,489	-1,255	467	-413
2035	1,489	-1,255	467	-413
2036	1,489	-1,255	467	-413

Ramping Category	2020 MW	2020 %Peak	2030 MW	2030 %Peak	Increased MW 2030 vs. 2020
1-hr Up	306	13.1%	468	20.5%	162
1-hr Down	-222	9.5%	-413	18.1%	191
Day Up	1,044	44.6%	1,489	65.2%	445
Day Down	-852	36.4%	-1,255	54.9%	403





QUANTA TECHNOLOGY

aes Indiana

(8) Resource Predictability & Firmness: Net Load Power Ramps (Y2030 vs Y2020)

Illustrative sample analyses, not related to AES-Indiana system or portfolios

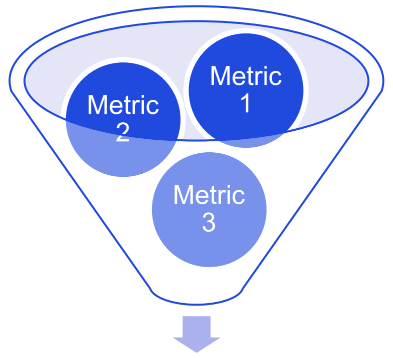
Portfolio	Solar	BTM Solar	Wind	Solar + Storage	Day Ramping Up (MW)	Day Ramping Down (MW)	1hr Ramping Up (MW)	1hr Ramping Down (MW)	Peaker/ Storage (MW)	Forecast Error 90th Percentile	Excess Ramping Capability (MW)
2020	**22**	**270**	**103**	**87**	**1,013**	**-860**	**243**	**-299**	**465**	**89**	**375**
P1	1,225	359	103	224	1,851	-1,557	506	-446	605	342	262
P2	1,725	359	103	224	1,988	-1,557	591	-455	605	434	171
P3	2,225	359	103	224	1,988	-1,557	676	-682	605	526	79
P4	2,725	359	103	224	2,258	-1,827	801	-817	1,225	618	607
P5	3,225	359	103	224	2,258	-1,827	872	-817	1,225	710	515
P6	3,975	359	103	224	2,258	-1,827	936	-817	1,225	848	377
P7	4,225	359	103	224	2,438	-2,007	1,026	-907	2,365	894	1,471
P8	4,225	359	103	224	2,438	-2,007	1,026	-907	2,365	894	1,471
P9	4,225	359	103	224	2,438	-2,007	1,026	-907	2,365	894	1,471

QUANTA TECHNOLOGY aes Indiana

	Reliability Study Area	Normal (50/50, Connected)	Max-Gen (90/10, Import Limited)	Islanded (Critical Load)
1	Energy Adequacy		X	X
2	Operational Flexibility and Frequency Support	X		X
3	Short Circuit Strength Requirement	X		X
4	Power Quality (Flicker)	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		

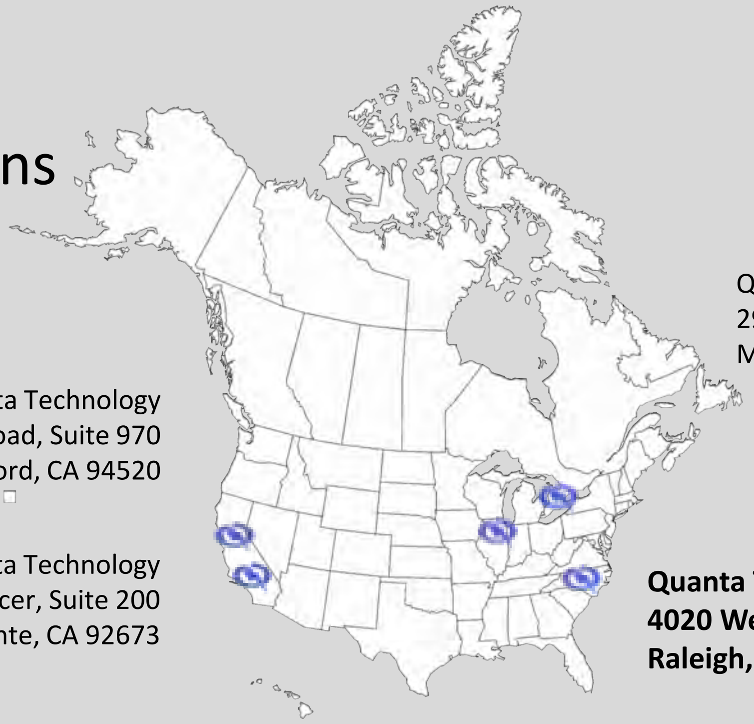
Scoring Criteria

Evaluate Portfolios



Thank you

Office Locations



Quanta Technology Canada, Ltd.
2900 John Street, Unit 3
Markham, Ontario, L3R 5G3

Quanta Technology
2300 Clayton Road, Suite 970
Concord, CA 94520

Quanta Technology
905 Calle Amanecer, Suite 200
San Clemente, CA 92673

Quanta Technology, LLC (HQ)
4020 Westchase Blvd., Suite 300
Raleigh, NC 27607

(919) 334-3000

quanta-technology.com

info@quanta-technology.com

LinkedIn.com/company/quanta-technology

Join us on LinkedIn and visit our website
for live Knowledge Sharing Webinars and more!

Portfolio Metrics & Scorecard

Erik Miller, Manager, Resource Planning, AES Indiana

Guidance for the IRP Scorecard Framework

Categorical Framework for AES Indiana's IRP Scorecard

Each category has one or more metrics that quantitively measure portfolio performance.

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

Affordability Metric

PVRR =

Operating Expenses
- Energy Purchases
- Fuel
- Variable O&M
- Fixed O&M
- Emissions

\+

Recovery of and Return on New Capital
- Book Depreciation
- Return on Rate Base
- Property Taxes

−

Market Revenues
- MISO Energy Revenue
- Net Capacity Revenue

Environmental Sustainability Metrics