2025 Integrated Resource Plan (IRP)

Public Advisory Meeting #1

January 29, 2025

aes Indiana

Agenda and introductions

Stewart Ramsay, Managing Executive, Vanry & Associates

Agenda

Time	Topic	Speakers
Morning Starting at 10:00 AM	Safety Message and Virtual Meeting Protocol	Claire Rice, Senior Director, Corporate Affairs & Impact, AES Indiana
	Welcome and Overview of AES Indiana	Brandi Davis-Handy, President, AES Indiana
	Overview of IRP & Resource Planning Model	Erik Miller, Director, Resource Planning, AES Indiana
	2022 IRP Recap	Erik Miller, Director, Resource Planning, AES Indiana
	Overview of Existing Resources and Replacement Resource Options	Erik Miller, Director, Resource Planning, AES Indiana
Break 11:45 AM – 12:15 PM	Lunch	
Afternoon Starting at 12:15 PM	Data Center Potential	Erik Miller, Director, Resource Planning, AES Indiana
	Baseline Energy and Peak Forecast	Mike Russo, Forecast Consultant, Itron
	Electric Vehicle (EV) and Solar PV Forecasts	Woody Zhu, EV & PV Modeling Forecasting, Carnegie Mellon University
	DSM Market Potential Study Introduction	Jeffrey Huber, Overall Project Manager and MPS Lead, GDS Associates
	Final Q&A and Next Steps	

IRP team introductions

AES IRP Leadership Team

Brandi Davis-Handy, President, AES Indiana
Guga Garavaglia, Chief Financial Officer, AES US Utilities
Patrick Maguire, Senior Director, Commercial, AES US Utilities

AES Indiana IRP Planning Team

Erik Miller, Director, Resource Planning, AES Indiana
Ryan Yang, Load Forecasting Analyst, AES Indiana
Michael Hardie, Resource Planning Analyst, AES Indiana
Brent Selvidge, Engineer, AES Indiana
Quintin Thompson, DSM Research Analyst, AES Indiana
Chad Rogers, Director, Regulatory Affairs, AES Indiana
Claire Rice, Senior Director of Corporate Affairs and Impact, AES Indiana

AES Indiana IRP Partners

Eric Fox, Director, Forecasting Solutions, Itron
Mike Russo, Forecast Consultant, Itron
Woody Zhu, Assistant Professor of Data Analytics, Carnegie Mellon University
Jeffrey Huber, Overall Project Manager and MPS Lead, GDS Associates
Jacob Thomas, Project Manager, GDS Associates
Hisham Othman, Senior Vice President, Quanta Technologies
Christina Owens, Director, Resource Planning, ACES
Will Vance, Director, Capacity Markets and Fundamental Analysis, ACES
Stewart Ramsey, Managing Executive, Vanry & Associates

AES Indiana Legal Team

Nick Grimmer, Indiana Regulatory Counsel, AES Indiana
Teresa Morton Nyhart, Counsel, Taft Law

Virtual meeting protocols and safety

Claire Rice, Senior Director, Corporate Affairs and Impact, AES Indiana

Safety message for virtual meetings

Space heater safety tips

→ Always place a space heater on a hard, level surface.

→ Keep your heater at least three feet away from anything flammable.

→ Never leave a space heater running when a room is unoccupied.

→ Only plug your space heater directly into a wall outlet. Never use an extension cord or power strip.

→ Don't place space heaters under desks or areas with little ventilation.

Virtual meeting protocol

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 your camera is on, please refrain from distractions.

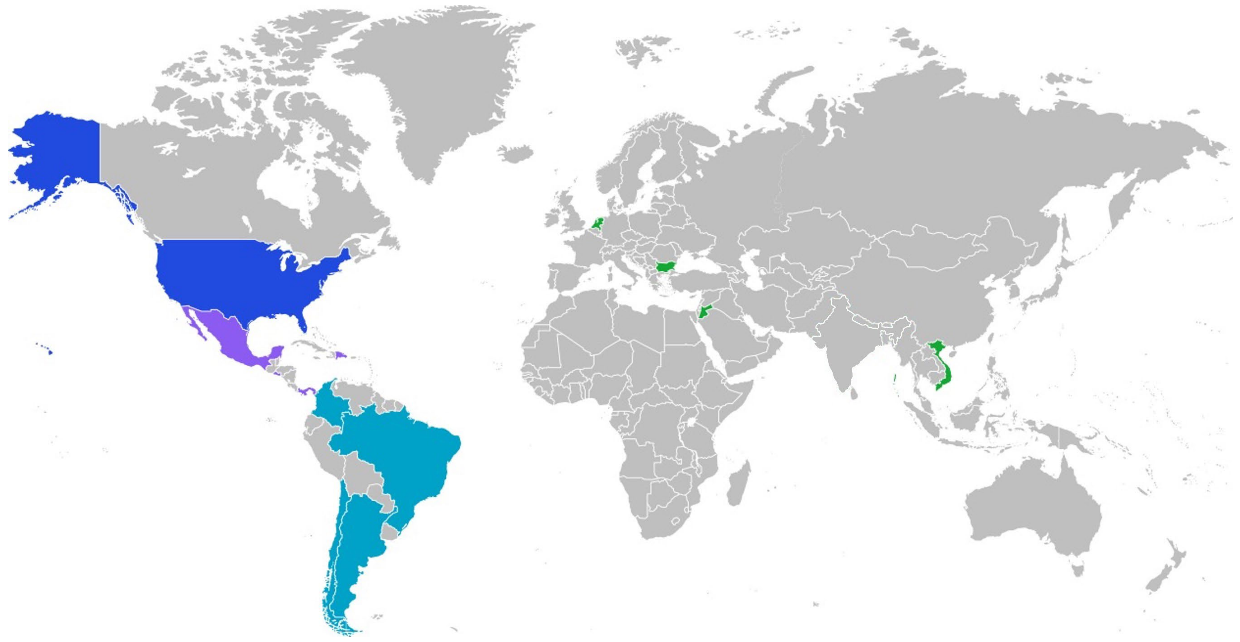
Welcome & overview of AES Indiana

Brandi Davis-Handy, President, AES Indiana

The future of energy is here.

- Reliability
- Resiliency
- Stability
- Affordability
- Sustainability

AES overview: Global Scale



36,740 MW

Gross MW in operation*

*25,159 proportional MW (gross MW multiplied by AES' equity ownership percentage).

3,978 MW

Generation capacity under construction or with signed PPAs

$45 billion

Total assets owned & managed

4 Continents

12 Countries

6 Utility companies

2.6 million

Customers served

9,600 people

Our global workforce

Recognized for our commitment to sustainability

Great Place To Work®

2024 WORLD'S MOST ETHICAL COMPANIES® ETHISPHERE 11 Time Honoree

FTSE4Good

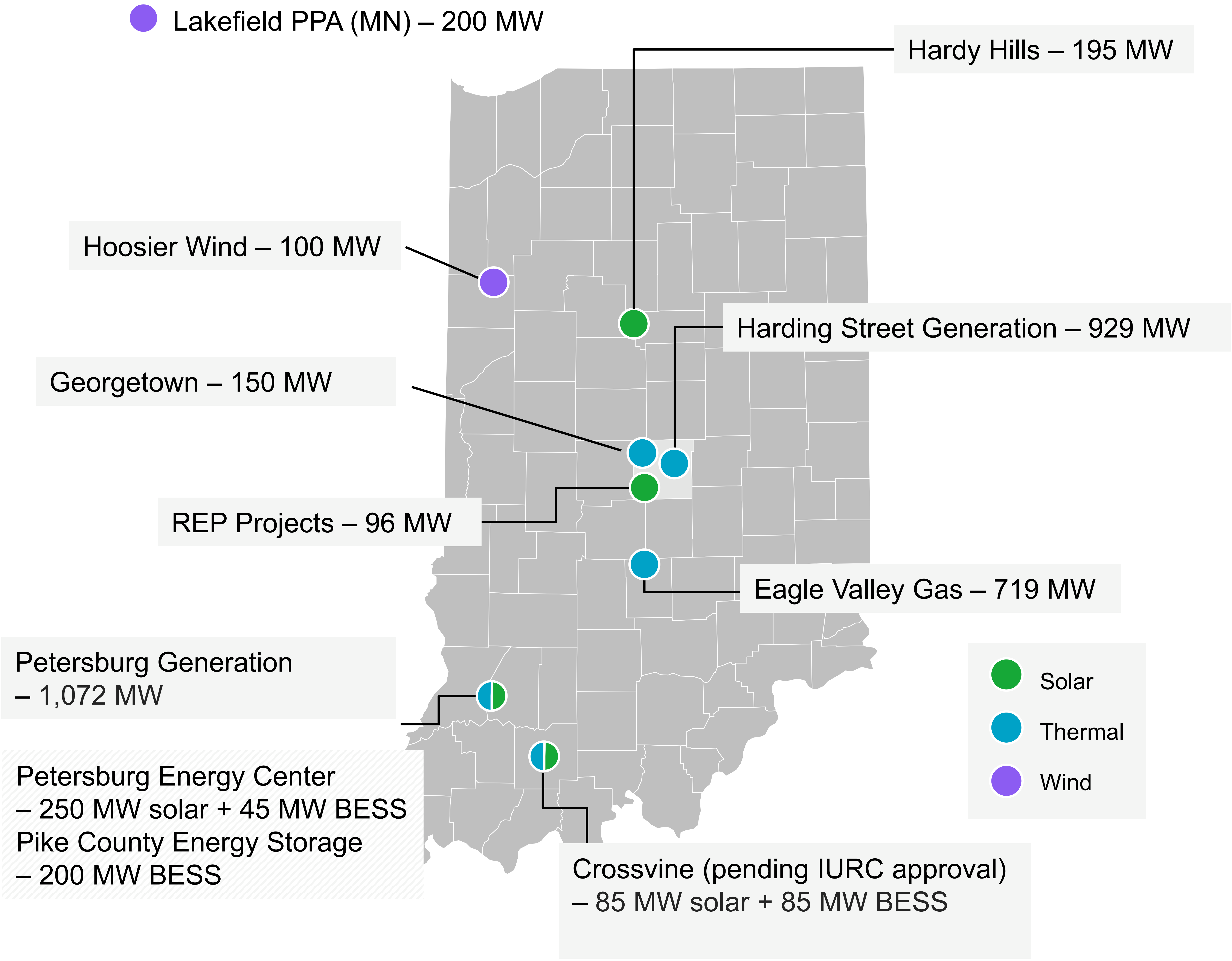
FAST COMPANY

aes Indiana

528
square miles

530,000
customers

3,956
MW of Generation



AES Indiana overview: Local impact

Customer centricity

Create exceptional customer-focused experiences

Economic and community development

Community investments improving quality of life

Sustainability

Transforming to cleaner, greener technologies

Reliability

Modernizing our grid

Accelerating the future of energy, together

Accelerating our Energy Transition

2016
- → Eagle Valley Coal Retired
- → Harding Street Coal to Natural Gas Conversion

2018
- → Eagle Valley CCGT Commissioned

2021
- → Petersburg Unit 1 Retired

2023
- → Petersburg Unit 2 Retired

2024
- → Hoosier Wind Acquired
- → Hardy Hills Solar online
- → Pike BESS online

2025
- → Crossvine Solar + Storage anticipated order

2026
- → Petersburg Energy Center solar + storage come online
- → Petersburg Units 3 & 4 repowered to Natural Gas

Overview of IRP & resource planning model

Erik Miller, Director, Resource Planning, 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?

→ The term '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 Q4 of 2025.

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

2025 IRP Timeline

Assumption gathering
- Market potential study for DSM
- Load forecast & other load items
- Other inputs & assumptions

Modeling & portfolio selection
- Core IRP modeling
- Portfolio evaluation

Preferred resource portfolio & short-term action plan

All-source resource request for proposals issued October 2024

Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

2024 **2025**

File IRP on November 1, 2025

IRP Technical Meetings will be held one week before each Public Advisory Meeting

Public Advisory Meeting #1 – Jan 29
- → IRP & Modeling Overview
- → Existing & Replacement Resources
- → Load Items

Public Advisory Meeting #2 – Mar/Apr
- → DSM Modeling Inputs
- → Replacement Resource Inputs
- → Commodity Inputs

Public Advisory Meeting #3 – June/July
- → Portfolio Matrix Framework
- → Scorecard Framework
- → Reliability Analysis

Public Advisory Meeting #4 – Aug/Sep
- → Preliminary Results & Portfolio Matrix Review
- → Risk Analysis

Public Advisory Meeting #5 – Oct
- → 2024 Modeling Insights
- → Preferred Resource Portfolio & Short-Term Action Plan

2025 IRP Process Roadmap

Assumption Gathering

Load Forecast
- Itron SAE Modeling Approach
- Base, High and Low Load Scenarios
- Customer EV & DG Scenarios

DSM Market Potential Study
- End Use Analysis of Efficiencies
- Develop Tech, Economic & Achievable Potentials
- Create DSM Inputs for EnCompass

Costs for New Resources
- RFP issued October 2024
- RFP Results used to inform new Resource Costs

Other Inputs & Assumptions
- Discount Rate
- Commodity Prices
- MISO Resource Accreditation & PRMs
- Modeling Parameters & Constraints

Distribution System Plan
- Circuit Level Analysis
- Assess EV, DG & DER Impacts
- Non-wires Alternatives

Modeling & Portfolio Selection

Capacity Expansion Modeling
- Portfolio Optimization & Retirement and Replacement Analysis

Production Cost Modeling, Stochastic Analysis & PVRR
- Portfolio Dispatch Analysis & calculation of PVRR
- Risk Analysis

Portfolio Evaluation & Scorecard
- Evaluation of the Scorecard & the Five Pillars
- Identify Preferred Resource Portfolio

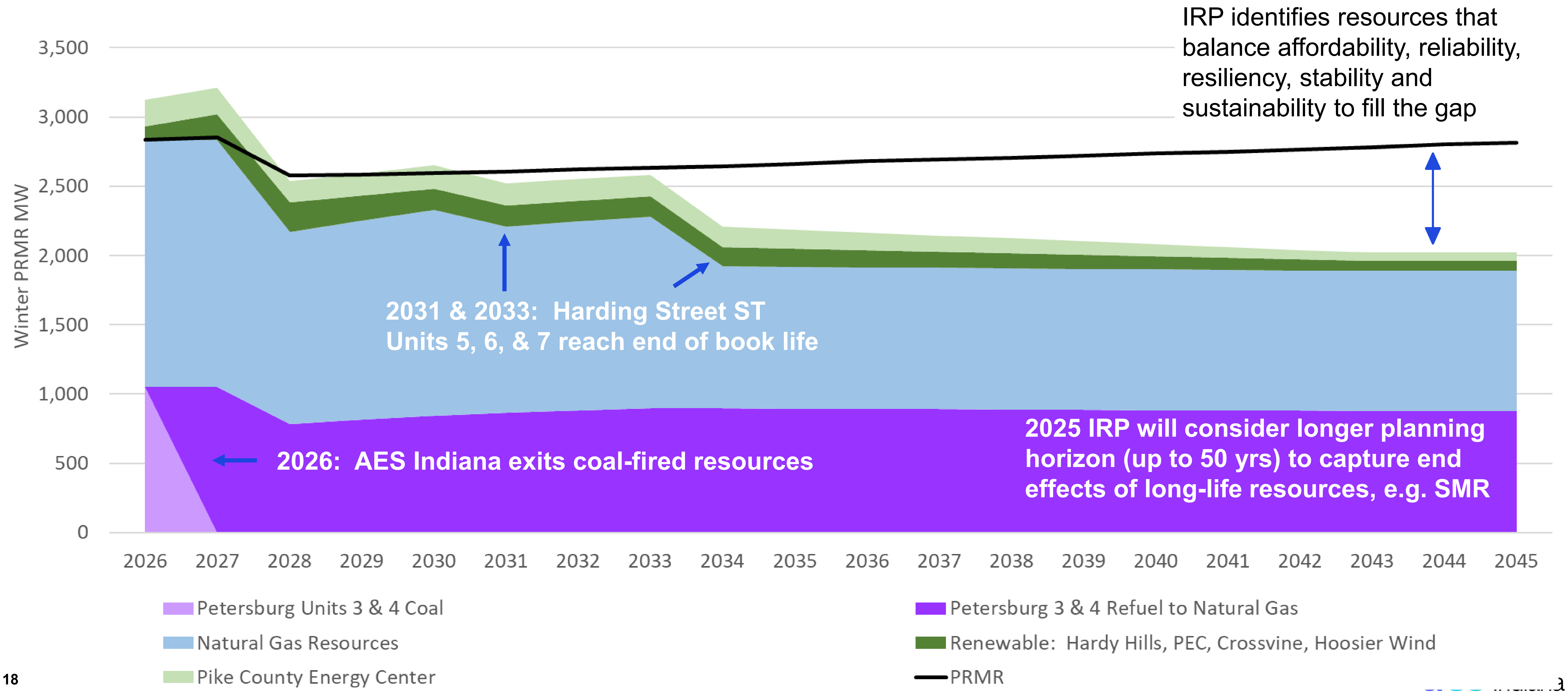
2025 IRP Contributors:
- **ACES** – Stochastic Analysis & Fundamental Market Curves
- **GDS** – DSM Market Potential Study
- **Itron** – Load Forecasting
- **Carnegie Mellon University** – Customer Electric Vehicle & Solar Forecasts
- **Quanta** – Reliability Analysis

IRP Submitted Nov. 1, 2025

IRP-related Filings
- Certificate of Public Convenience and Necessity (CPCN)
- Demand Side Management Plan

How exactly does IRP modeling work?

We are using the “Five Pillars” to identify resources to fill in any generation shortfalls that we have during the planning period.



IRP scorecard analysis & components

Scorecard that evaluates the portfolios using the Five Pillars of Utility Electric Service to select the Preferred Resource Portfolio

→ Scorecard analysis will be performed on the Base Case set of portfolios

→ Scorecard categories align with the Five Pillars of Utility Electric Service as required by statute
- Affordability
- Environmental Sustainability
- Reliability
- Resiliency
- Stability

→ Additional categories that measure the Risk & Opportunity and Economic Impact included to comply with IURC rules

→ Scorecard evaluation used to select the Preferred Resource Portfolio and Short Term Action Plan

Category	Metric	Description
Affordability	30- to 50-yr PVRR & 10-yr PVRR	Longer planning period to capture end effects from long life tech (SMR)
Environmental Sustainability	CO2 emissions	Total CO_2 emissions over planning period
	SO2 emissions	Total SO_2 emissions over planning period
	NOx emissions	Total NOx emissions over planning period
	Water user	Total water use over planning period
	Coal Combustion Products (CCP)	Total CCP emissions over planning period
	Clean energy progress	% of clean energy in portfolio by 2024
Reliability, Resiliency & Stability	Reliability score	Quanta Technology will perform reliability analysis on candidate portfolios
Risk & Opportunity	General cost opportunity **Stochastic analysis**	P5 (Mean – P5)
	General cost risk **Stochastic analysis**	P95 (P95 – Mean)
	Market exposure	20-yr sales & purchases
Economic impact	TBD	TBD

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EnCompass Overview

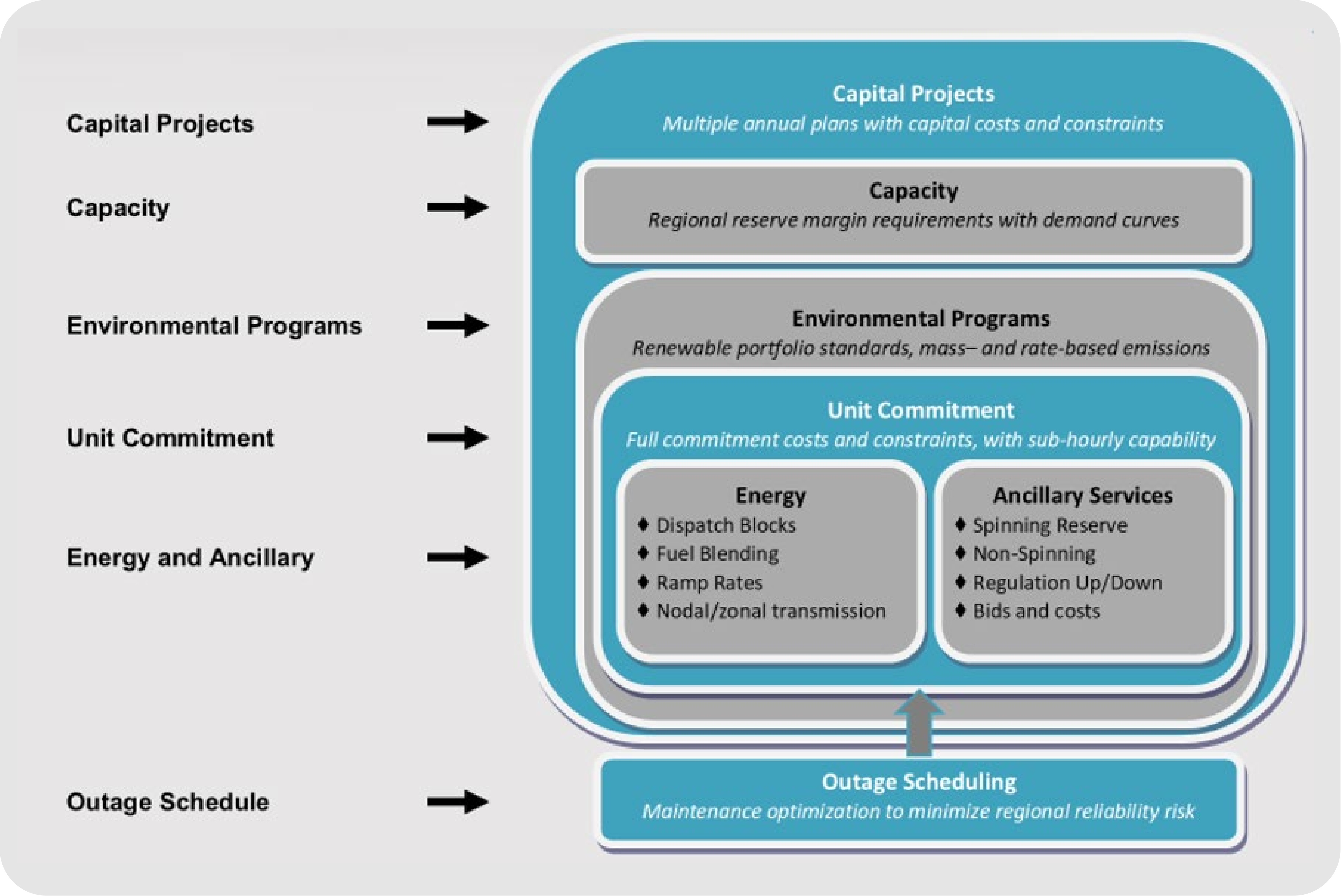
→ EnCompass models thermal, renewable, storage, nuclear and load resources with hourly granularity.

→ Model will be used for capacity expansion analysis to make long-term resource decisions based on scenario input assumptions.

→ 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



Advantages of EnCompass

Key Advantages of Utilizing EnCompass

→Quick run times

- → Allows for robust 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

- → Complete models can be fully shared with other EnCompass users
- → Spreadsheet files can be shared with non-users

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2022 IRP recap

Erik Miller, Director, Resource Planning, AES Indiana

2022 IRP – Short-term action plan

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

Repowering coal-fired generation

Repowering coal-fired generation in 2025/2026 after repowering Petersburg Units 3 and 4 to natural gas

Adding renewable generation

Add renewable generation for capacity and energy, which includes:

- → 200 MW ICAP of battery energy storage at Petersburg to fill winter capacity position in 2025
- → Additional wind and solar as energy replacement for Petersburg

Implementing 3-year DSM action plan

Implementing three-year DSM action plan that targets an annual average of 130,000 – 134,000 MWh of energy efficiency (approximately 1.1% of 2021 sales) and three-year total of 53 MW summer peak impacts of demand response

Petersburg repowering of Units 3 & 4

Project Information

→ Type: Steam turbine units repowered from coal-fired to gas-fired operation

→ Size: Approximately 1,000 MW of capacity maintained

→ COD: Unit 3 in 2026 first half, Unit 4 in 2026 second half

→ Location: Petersburg, IN

→ Project Manager: Internal with EPC contractor

Repowering Petersburg Units 3 & 4 from coal- to gas-fired operation will maintain the capacity value of units.

Pike County Battery Energy Storage System

Project Information

→ Type: Battery Energy Storage System (BESS)

→ Size: 800 MWhac BESS (200 MWac, 4-hour discharge power capacity)

→ COD: 2025

→ Location: Pike County, IN

→ Developer: Internal with EPC contractor

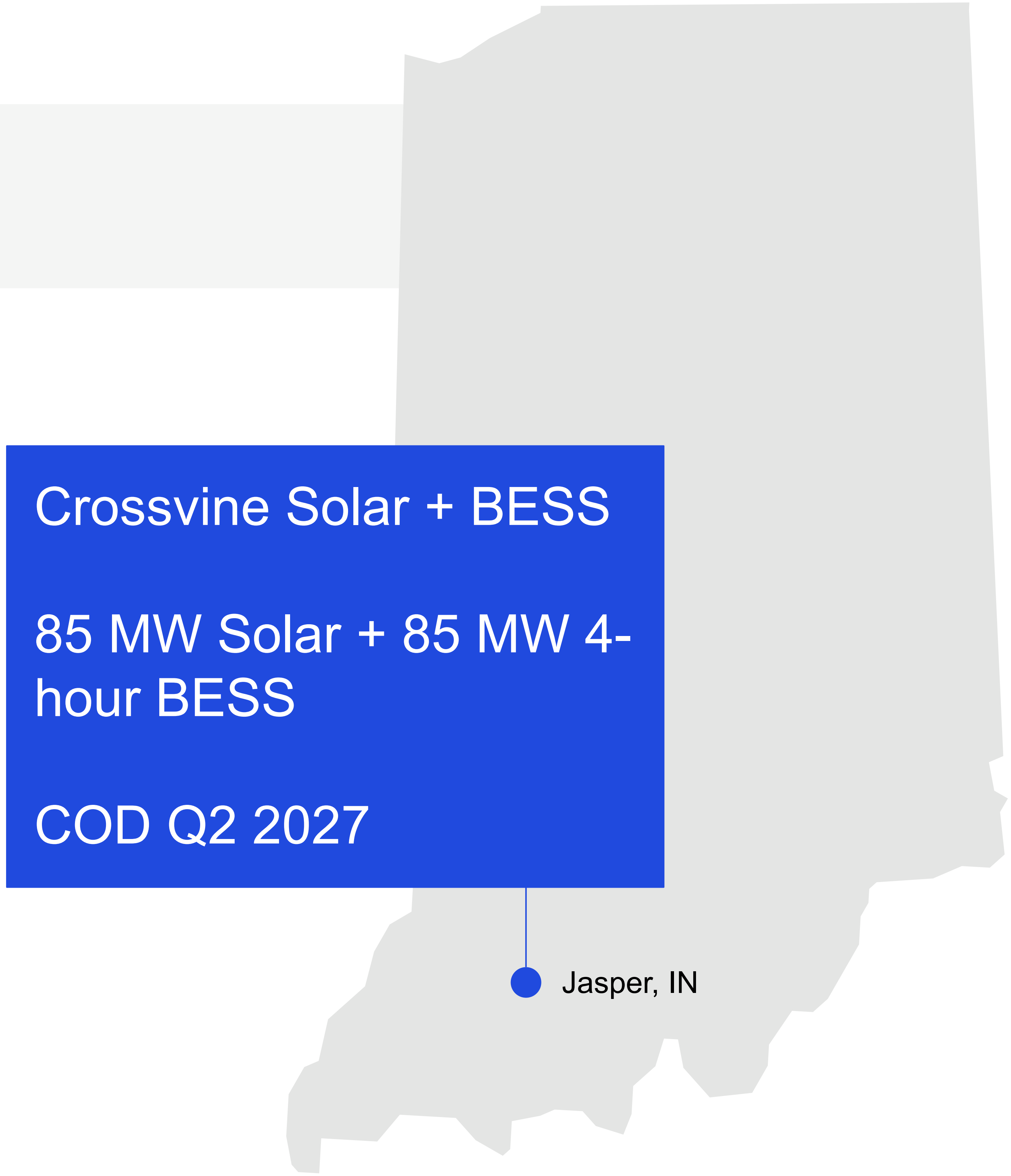
Pike County BESS will initially contribute 190 MW of capacity in each season to AES Indiana's portfolio.

Crossvine Solar + BESS

Project Information

- → Type: Solar and battery energy storage facility
- → Size: 85 MWac ICAP coupled with a 340 MWh DC battery energy storage system (85 MWac, 4-hour discharge power capacity)
- → COD: Q2 2027
- → Location: Dubois County, IN
- → Developer: BP Lightsource

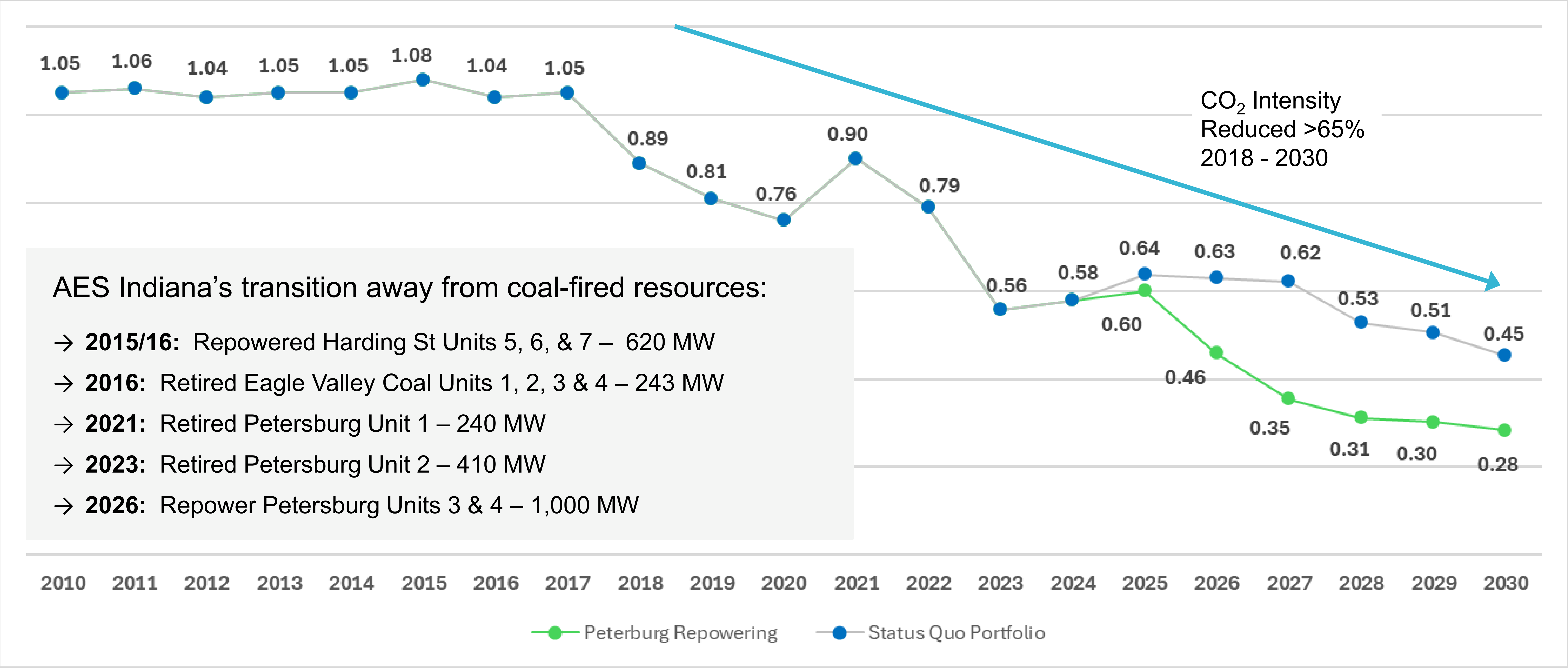
Crossvine will initially contribute 80 MW of winter capacity to AES Indiana’s portfolio.



Portfolio changes will reduce carbon intensity by over 65% by 2030.

After repowering Petersburg Units 3 & 4 in 2026, AES Indiana will no longer have coal-fired resources in its fleet.

CO_2 intensity associated with AES Indiana fleet emissions



AES Indiana's transition away from coal-fired resources:

- → **2015/16:** Repowered Harding St Units 5, 6, & 7 – 620 MW
- → **2016:** Retired Eagle Valley Coal Units 1, 2, 3 & 4 – 243 MW
- → **2021:** Retired Petersburg Unit 1 – 240 MW
- → **2023:** Retired Petersburg Unit 2 – 410 MW
- → **2026:** Repower Petersburg Units 3 & 4 – 1,000 MW

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Overview of existing resources

Erik Miller, Director, Resource Planning, AES Indiana

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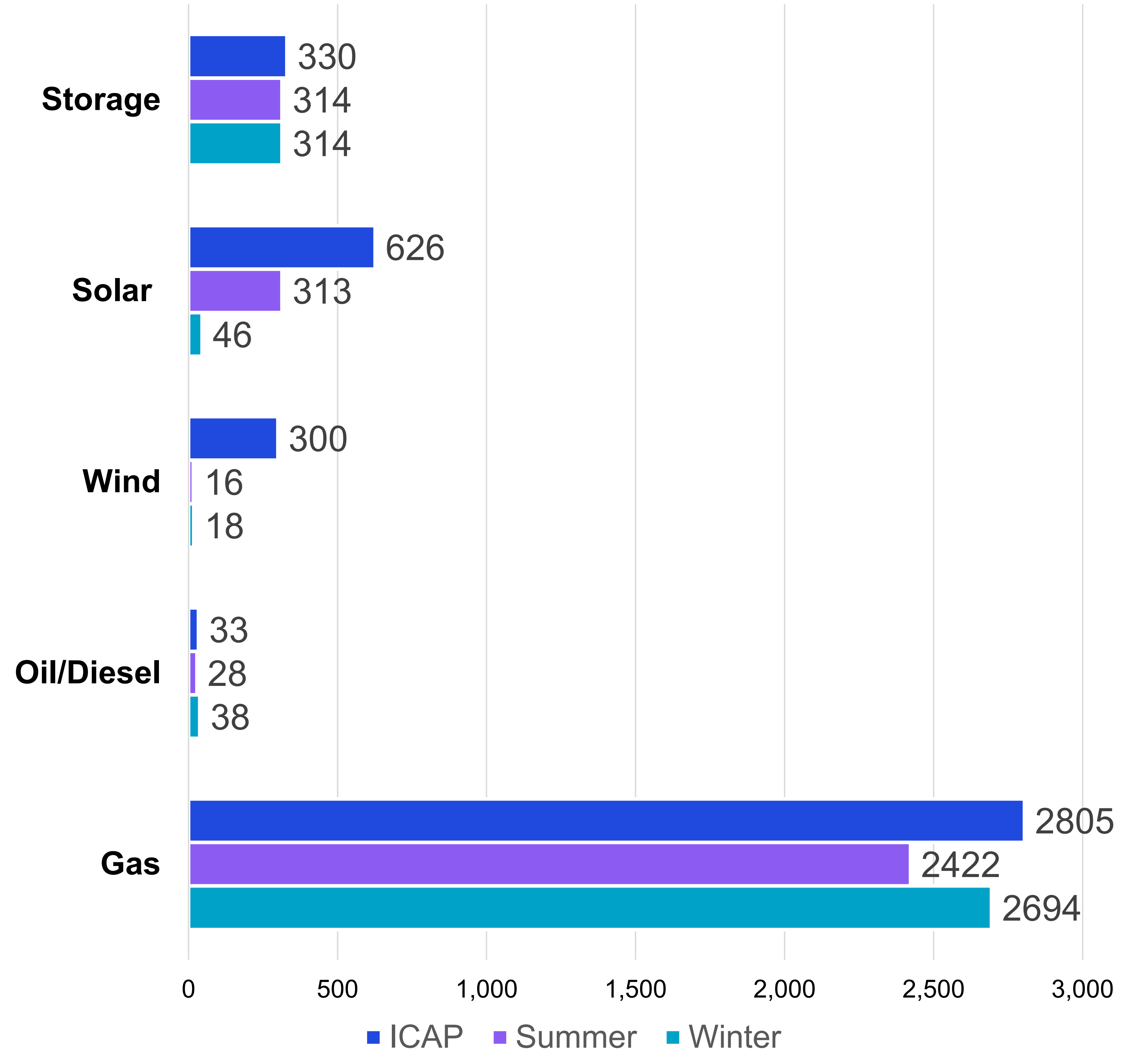
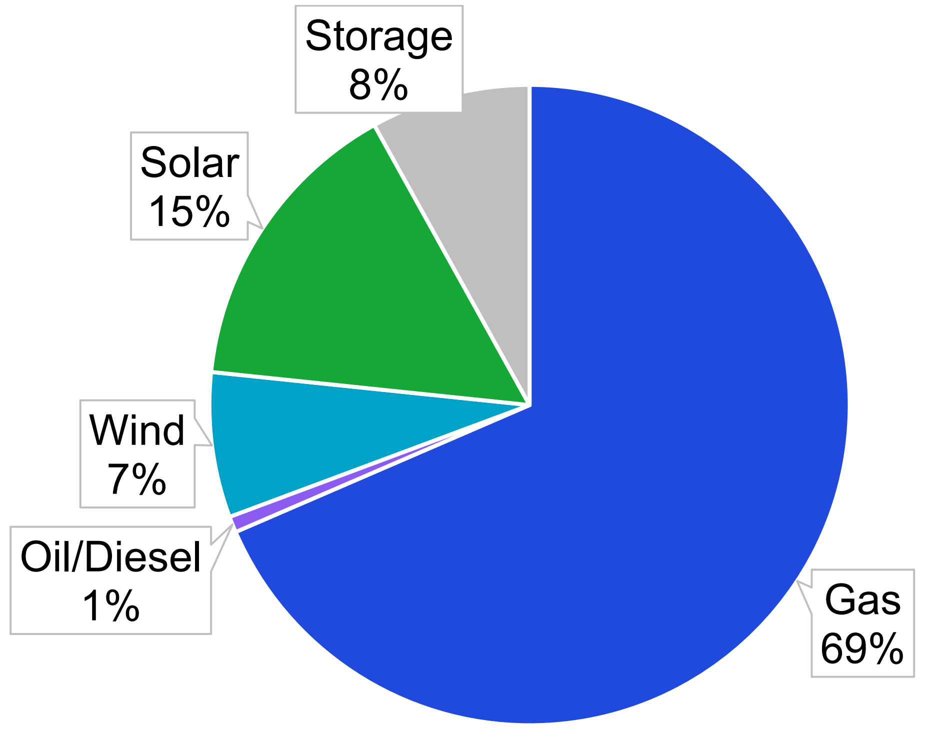
AES Indiana current generation mix

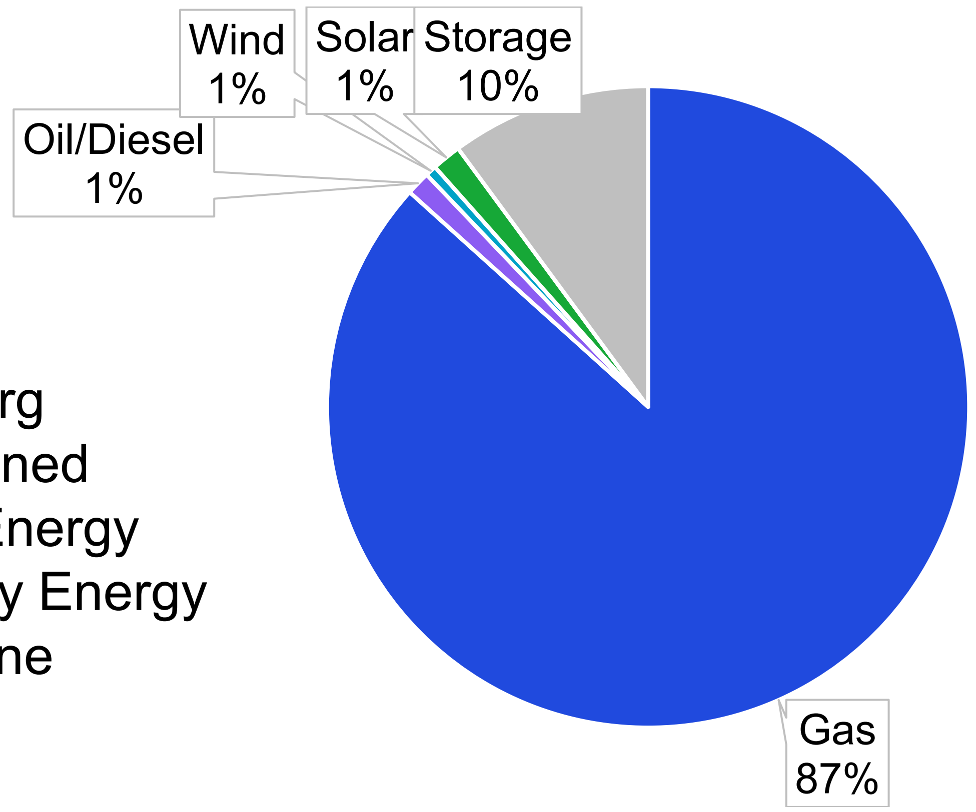
Resources – ICAP, Summer & Winter Accreditation (MW)*



ICAP (MW)*



Winter Accreditation (MW)*



*Includes Petersburg Repowering & planned generation: Pete Energy Center, Pike County Energy Storage, & Crossvine

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Petersburg 3 & 4 repowering

- **Petersburg Units 3 & 4** will be repowered from using coal to using natural gas for fuel during 2026; Unit 3 repowering in the first half 2026 and Unit 4 repowering in second half.
- **MISO capacity accreditation** of the repowered units is expected to remain approximately one-for-one post conversion.
- Table includes estimated accreditation using current MISO methodology and does not reflect future accreditation changes from MISO.

Coal Units	Technology	ICAP (MW)	Summer Accreditation (MW)	Winter Accreditation (MW)	In-Service Year	Estimated Last Year In-Service
Petersburg						
Pete ST 3 Coal	Coal ST (2025)	532	465	526	1977	2026
Pete ST 4 Coal	Coal ST (2025)	538	466	524	1986	2026
Pete ST 3 Gas	Gas Steam Turbine (Conversion in 2026)	532	465*	526*	1977	2042
Pete ST 4 Gas	Gas Steam Turbine (Conversion in 2026)	538	466*	524*	1986	2042
	Total Gas:	1070	931	1050		
	Total Coal:	1070	931	1050		

*Capacity accreditation expected to improve slightly after repowering due to improvement in auxiliary load of the units.

Existing gas resources

	ICAP (MW)	Summer (MW)	Winter (MW)
CCGT	682	667	556
CT	436	414	511
ST	1688	1342	1627

→ Table includes estimated accreditation using current MISO methodology and does not reflect future accreditation changes from MISO.

Gas Units	Technology	ICAP (MW)	Summer Accreditation (MW)	Winter Accreditation (MW)	In-Service Year	Estimated Last Year In-Service
Eagle Valley						
EV CCGT	Combined Cycle Gas Turbine	682	667	656	2018	2055
Harding Street						
HS ST 5	Gas Steam Turbine	96	80	106	1958	2030
HS ST 6	Gas Steam Turbine	102	96	77	1961	2030
HS ST 7	Gas Steam Turbine	420	236	395	1973	2033
HS CT 4	Combustion Turbine	73	70	77	1994	2044
HS CT 5	Combustion Turbine	75	69	85	1995	2045
HS CT 6	Combustion Turbine	146	142	178	2002	2052
HS GT1 & GT2	Oil/Diesel	33	28	38	1973	TBD
Georgetown						
GTOWN GT1	Combustion Turbine	72	69	86	2000	2050
GTOWN GT4	Combustion Turbine	69	65	86	2001	2052
	Total Gas:	2805	2422	2694		
	Total Oil:	33	28	38		

Existing & planned renewable resources

Renewables & BESS	Technology	ICAP (MW)	Summer Accreditation (MW)	Winter Accreditation (MW)	In-Service Year	Estimated Last Year In-Service
Hardy Hills Solar						
Hardy Hills Solar	Solar	195	98	10	2023	TBD
Petersburg Energy Center Solar + Storage						
PEC Solar	Solar + BESS	250	125	13	2025	TBD
PEC BESS	Solar + BESS	180 MWh, 45 MW 4-hr	43	43	2025	TBD
Pike County Energy Storage						
Pike County BESS	BESS	800 MWh, 200 MW 4-hr	190	190	2025	TBD
Crossvine Solar + BESS						
Crossvine Solar	Solar	85	43	4	2027	TBD
Crossvine BESS	BESS	340 MWh, 85 MW 4-hr	81	81	2027	TBD
Hoosier Wind						
Hoosier Wind (IN)	Wind	100	16	18	2011	2031
PPAs						
Lakefield Wind (MN)	PPA	200	0	0	2009	2029
Rate (REP Solar)	PPA	96	48	19	Varies	Varies
	Total:	**1256**	**1034**	**833**		

- **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.
- Table includes estimated accreditation using current MISO methodology and does not reflect future accreditation changes from MISO.

ICAP (MW)	ICAP (MW)	Summer (MW)	Winter (MW)
Wind	300	16	18
Solar	626	313	46
Storage	330	330	330

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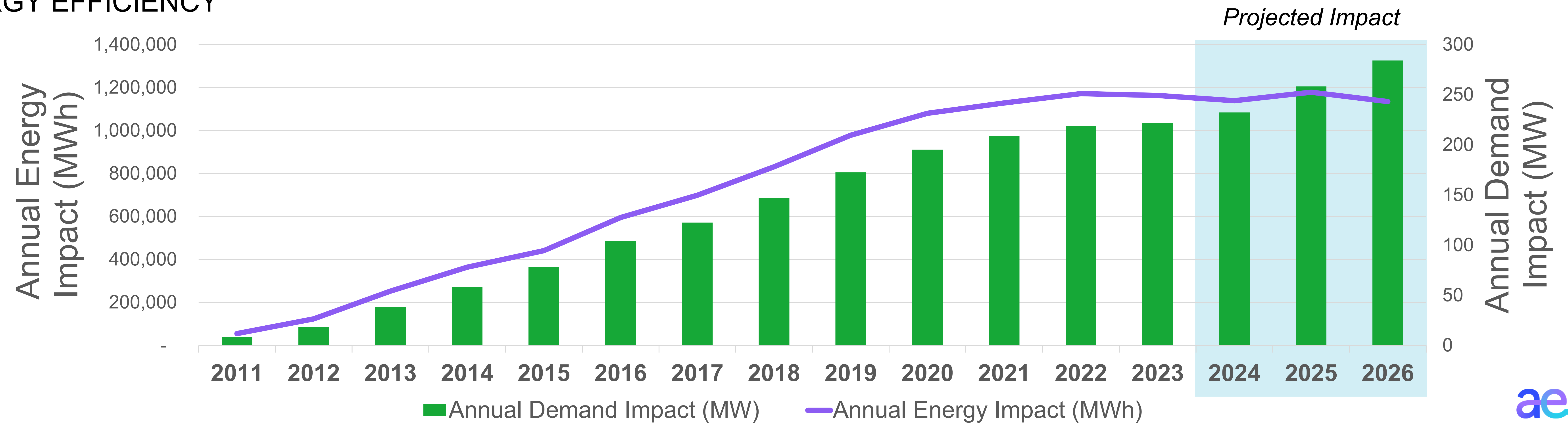
Existing DSM Resources

DEMAND RESPONSE

Load Modifying Resources	24-25 Summer Capacity Value (MW)
Air Conditioner Load Management (ACLM)	43.1
Rider 17	1.8
Rider 14	8.9

- → Avg annual incremental program savings of 1.1% per year of 2024 sales
- → Savings of approximately 8.4% of 2024 sales from measures installed to date
- → 11 DSM programs planned for 2025 and 2026

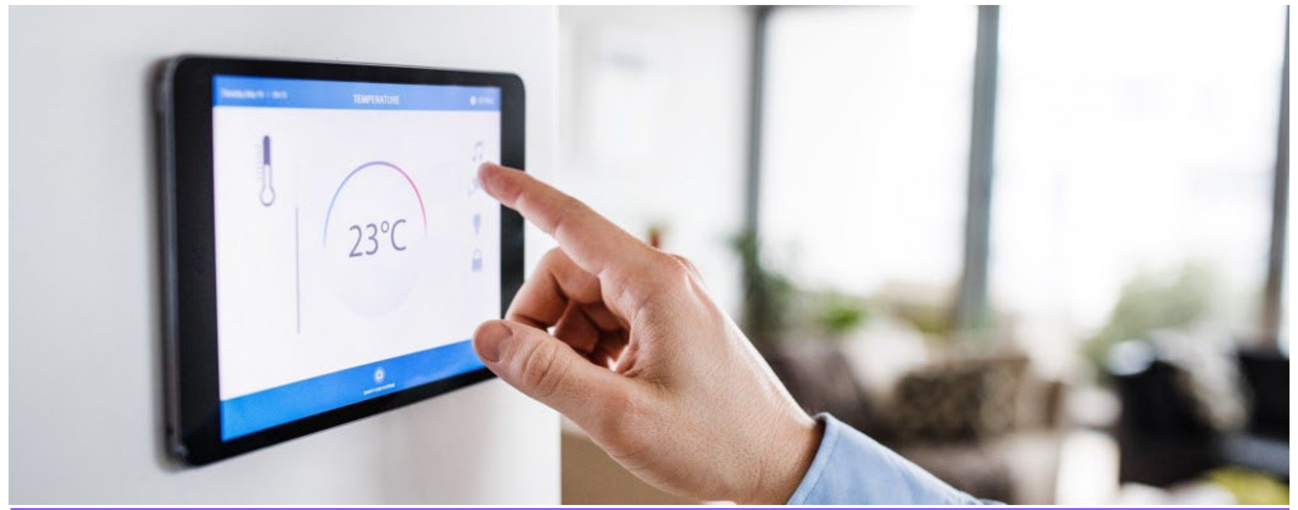
ENERGY EFFICIENCY



Replacement resource options

Erik Miller, Director, Resource Planning, AES Indiana

Commercially available replacement resources



DSM/EE

- → EE & DR measures bundled into tranches for planning model selection

Wind

- → Land-based wind

Solar

- → Utility-scale

Storage

- → Stand alone front-of-meter
- → Long duration storage
- → Solar + storage

Natural gas

- → CCGT
- → CT
- → Reciprocating Engine

Nuclear

- → Small Modular Reactors
- → Advanced Reactors

Data center potential

Erik Miller, Director, Resource Planning, AES Indiana

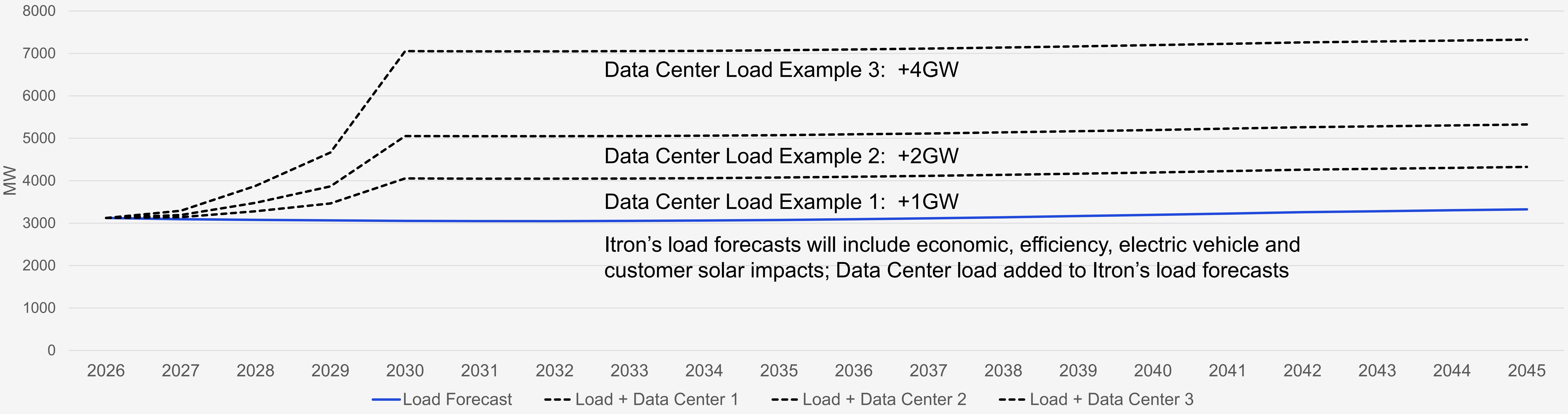
Data center load potential

AES Indiana will consider data center load scenarios in the 2025 IRP of up to 4GW by the mid-2030s.

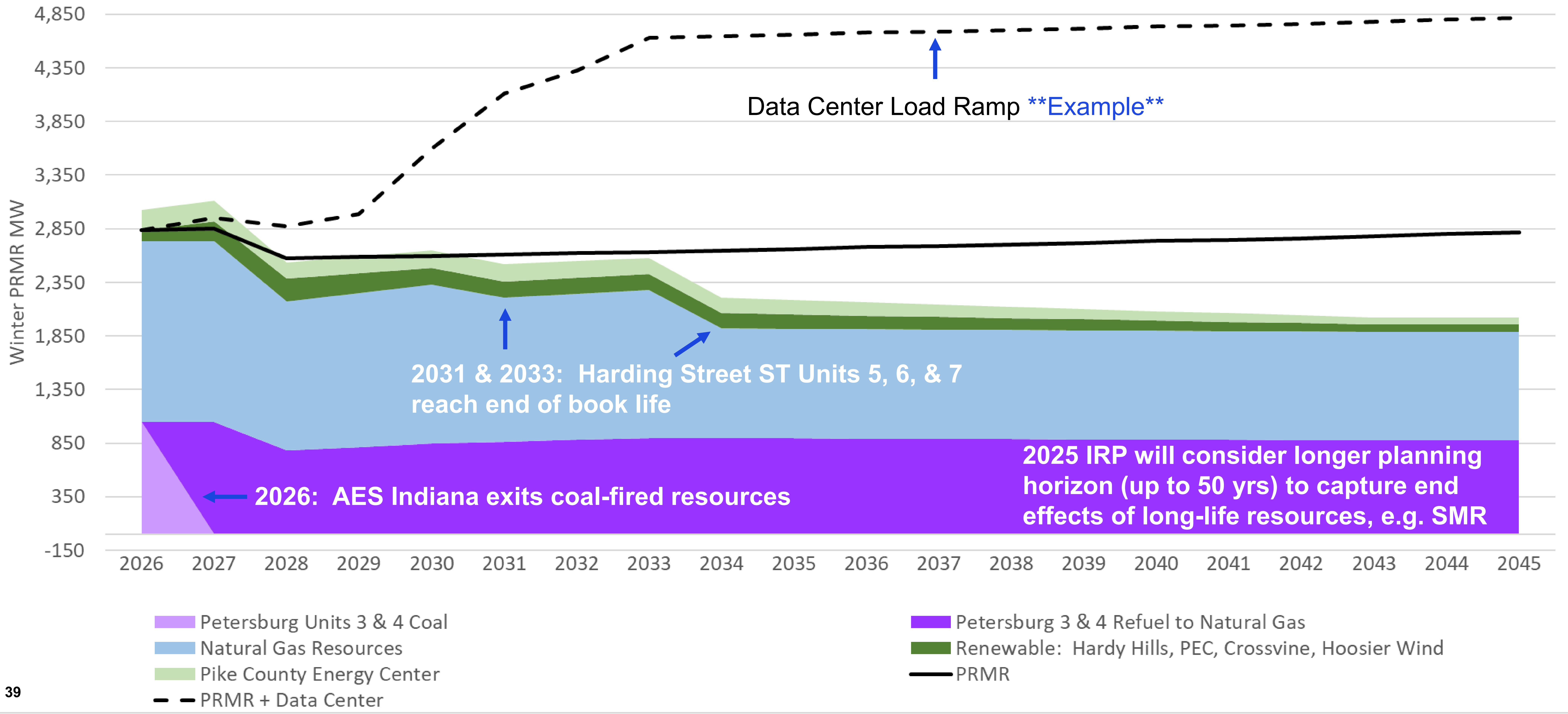
Data Center Load will be added to the load forecasts provided by Itron and considered in the IRP Scenario Analysis.

Still *to be determined* if Base/Reference Case Scenario will include data center load potential. Regardless, **AES Indiana will include a no data center load scenario as one of the scenarios in the IRP Scenario Analysis.**

Example load scenarios:



Starting IRP portfolio with data center example



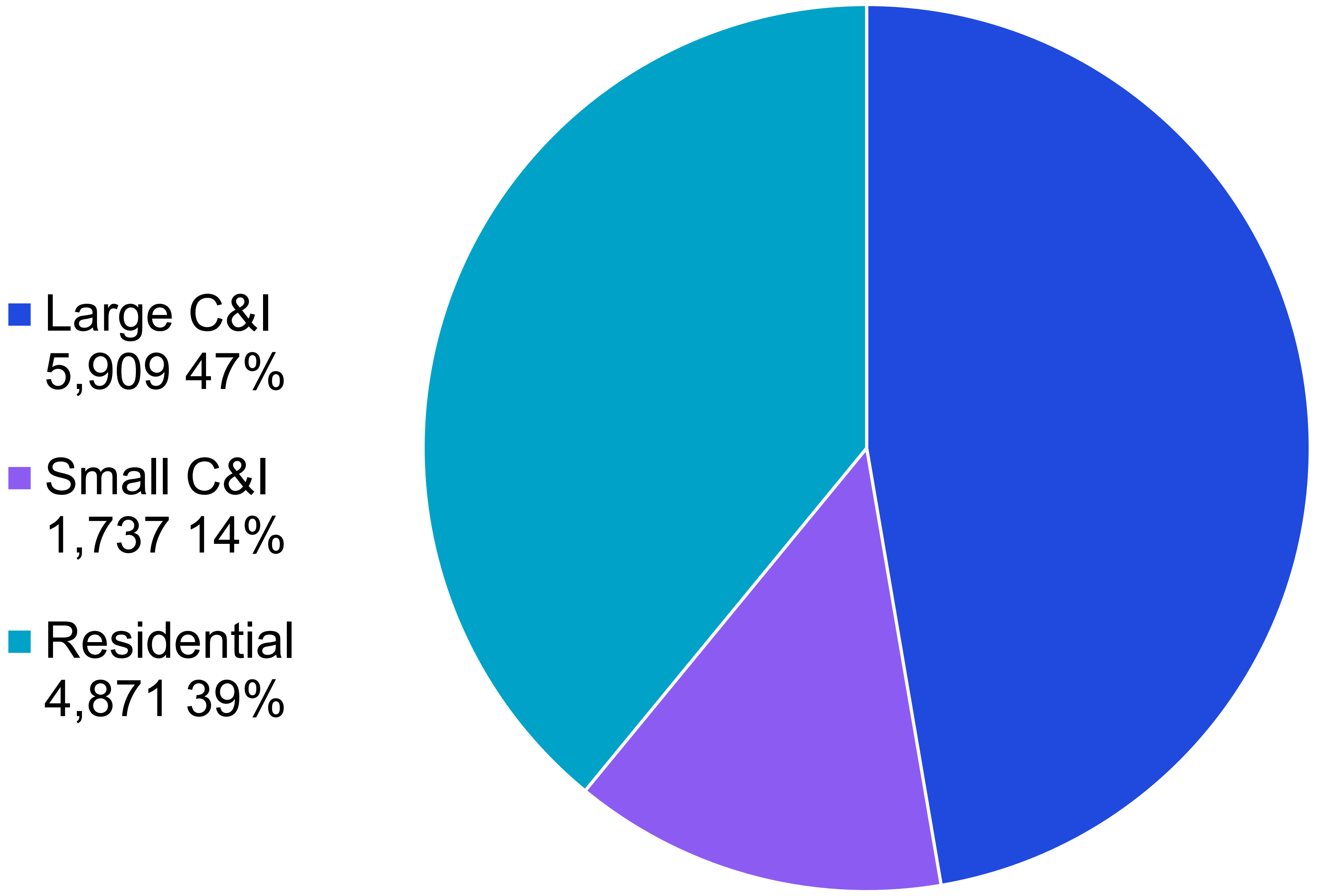
Baseline energy and peak forecast

Michael Russo, Forecasting Consultant, Itron

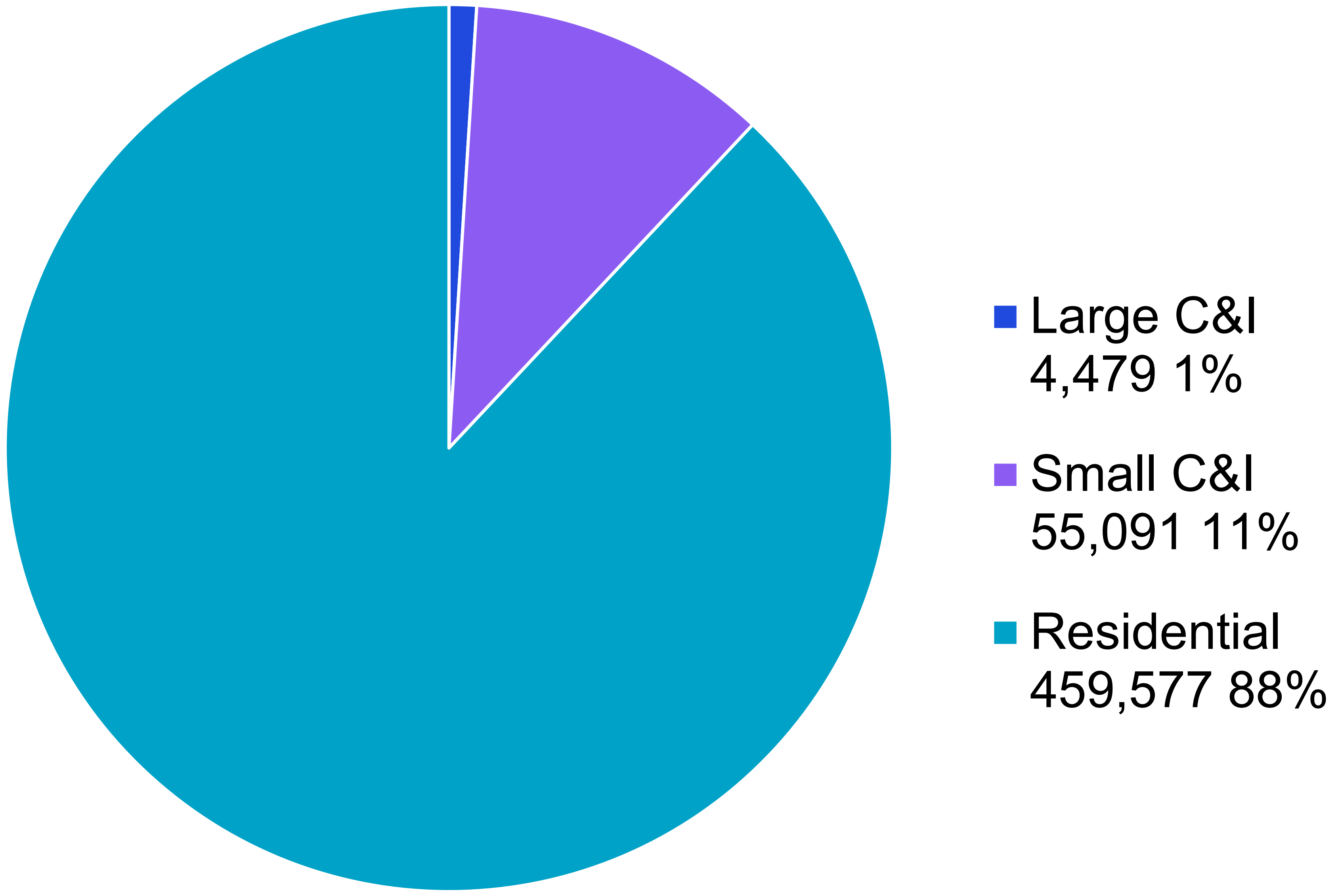
Sales, energy, and demand trends

AES Indiana customer class mix

2023 Sales Mix (GWh)



2023 Customer Mix



AES Indiana serves over 530,000 customers across residential, commercial, and industrial customer classes. The residential class accounts for nearly 90% of the customers and 39% of system sales. Small C&I sales are 14%. Large C&I sales 47%.

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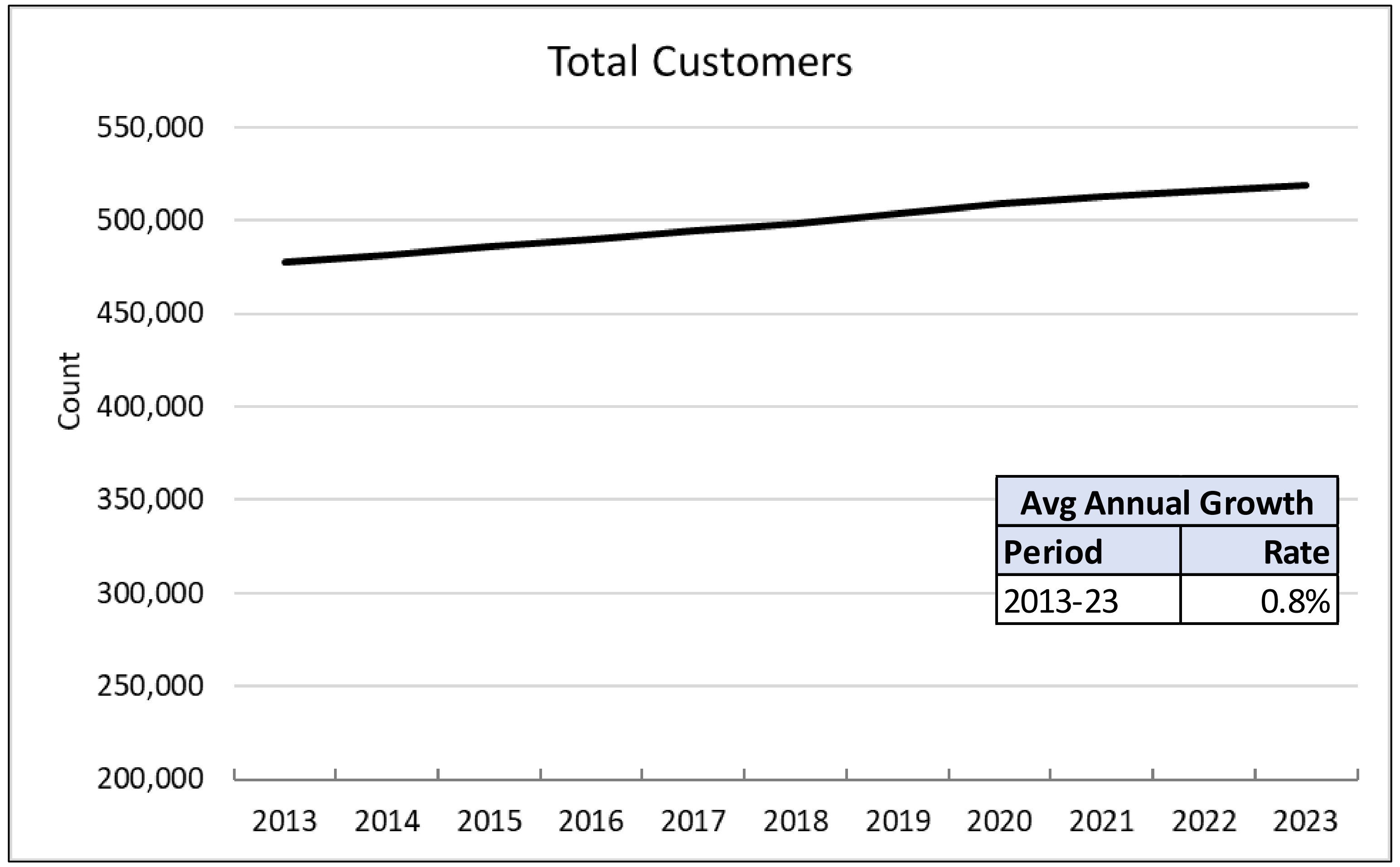
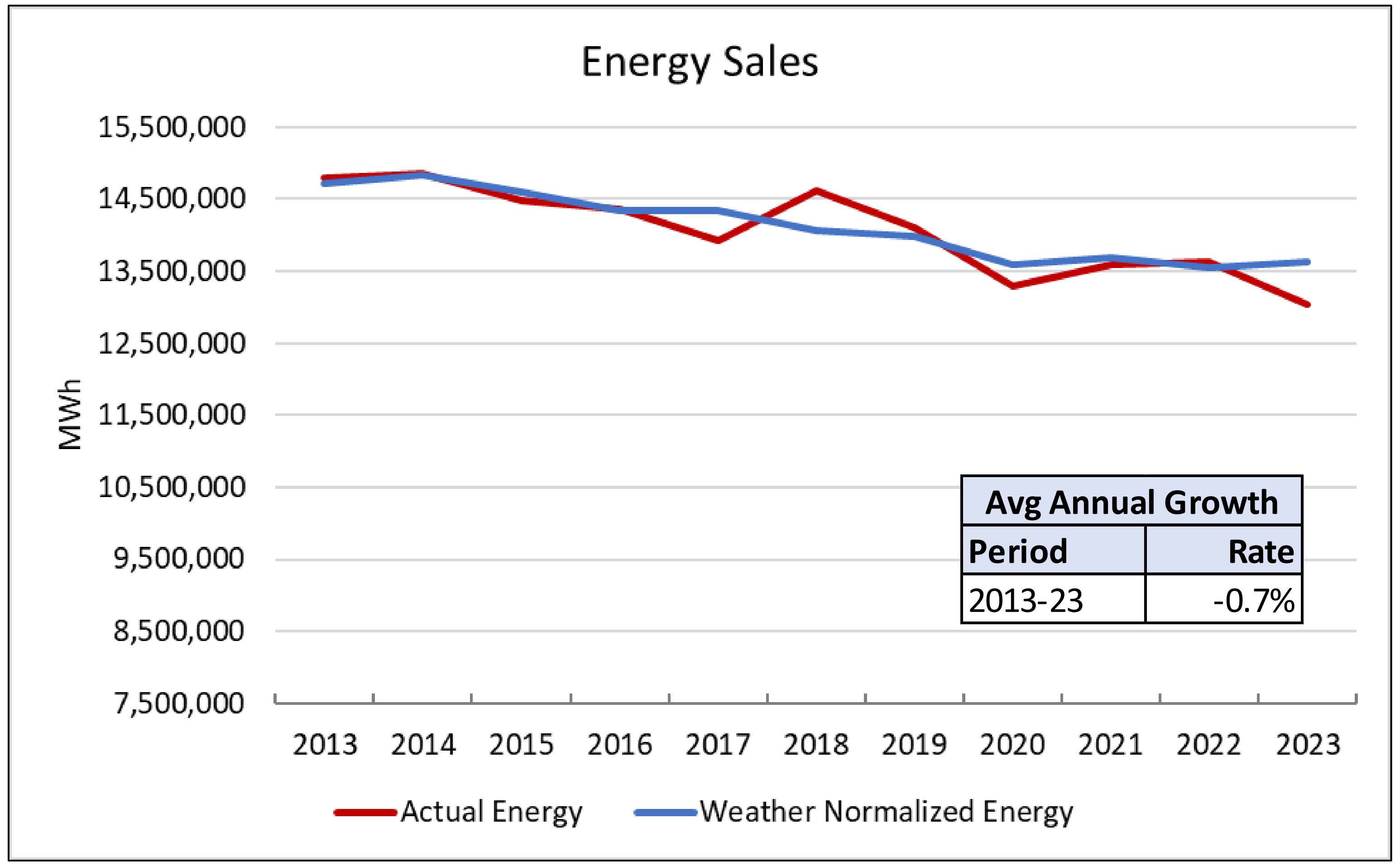
Historical Energy, Peak, and Customer Trends

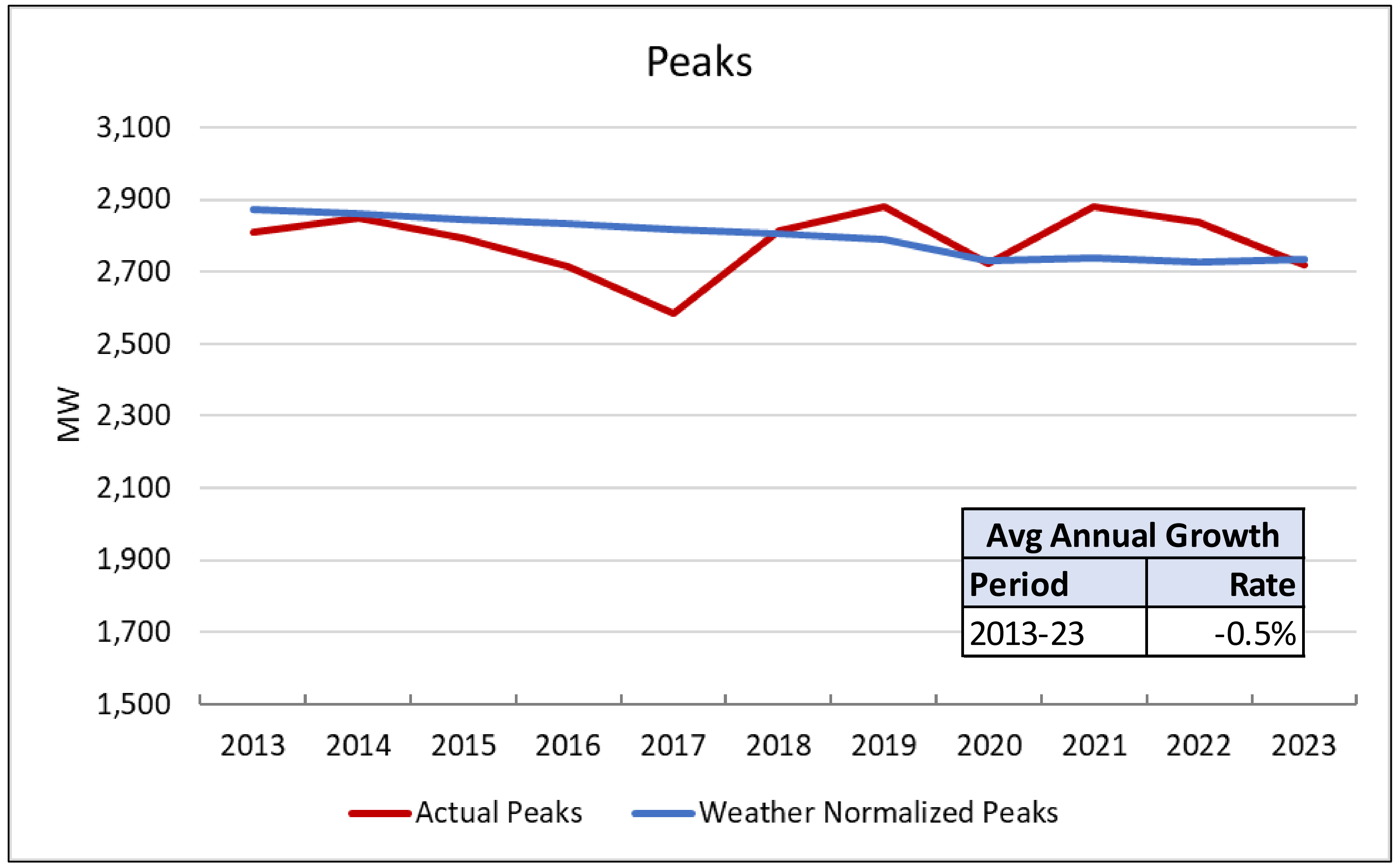




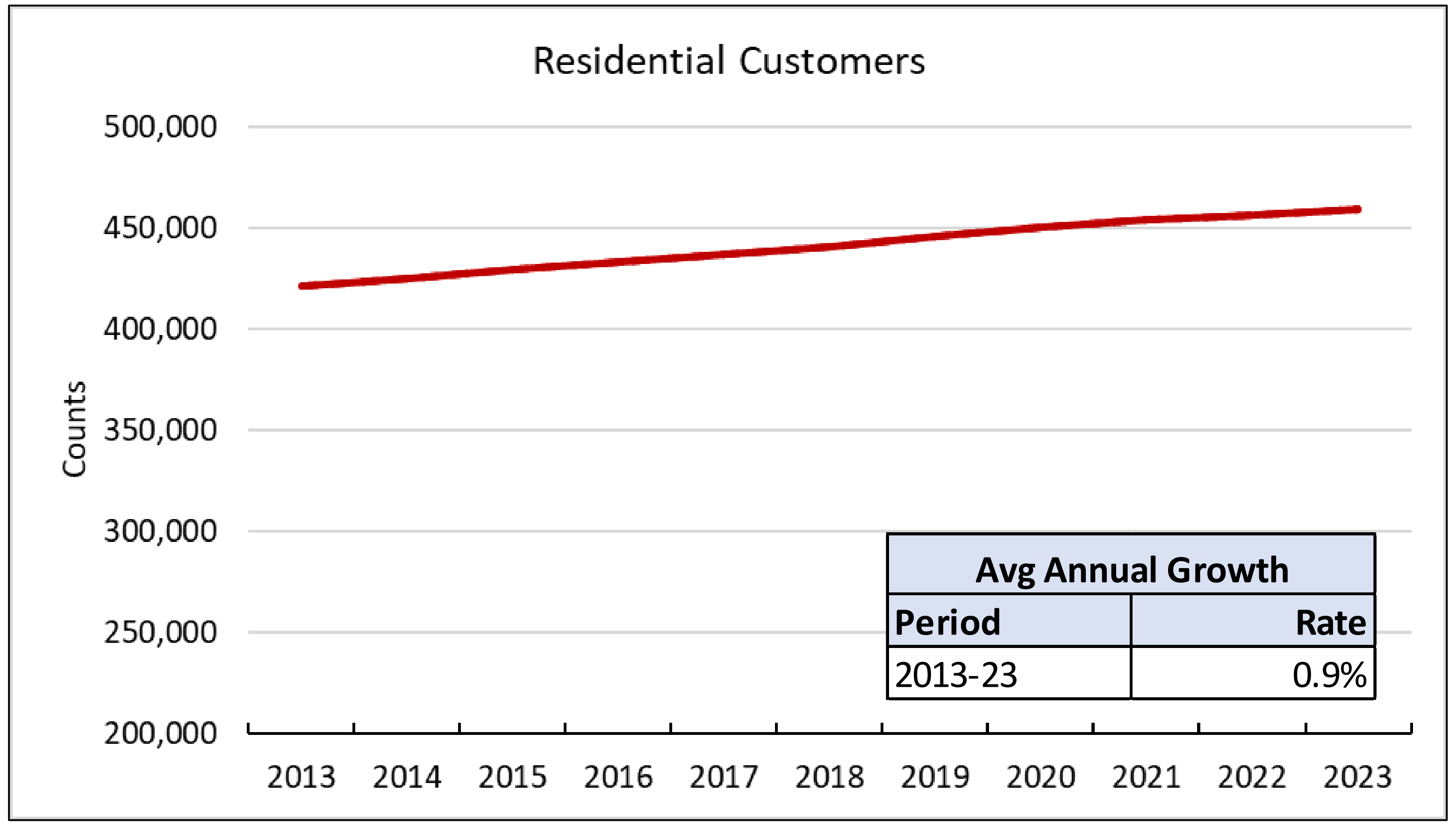
→ Strong customer growth

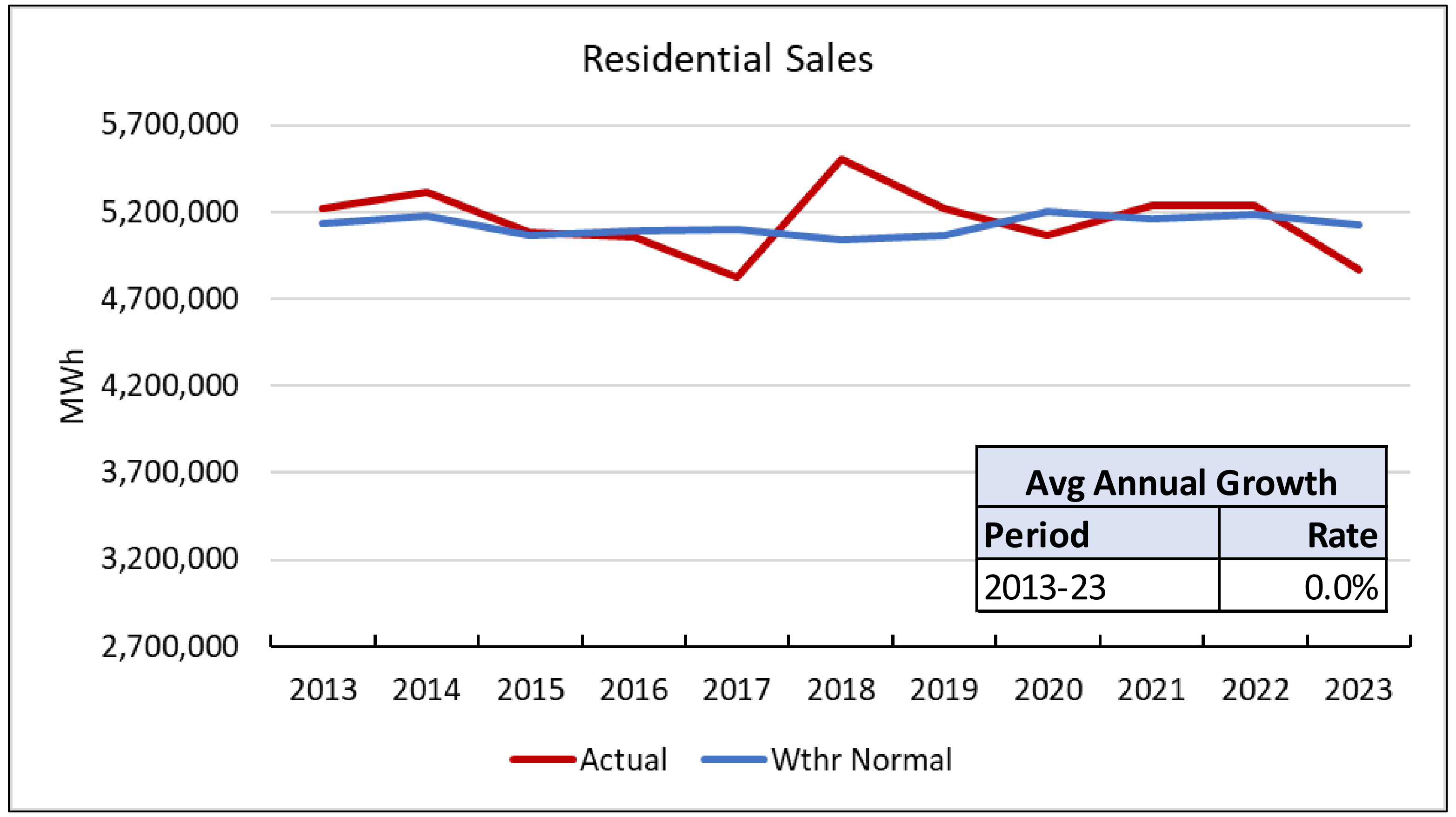
→ Slowing decline in energy and peaks

→ Energy and peaks have flattened 2019-2023 compared to 2013-2018.



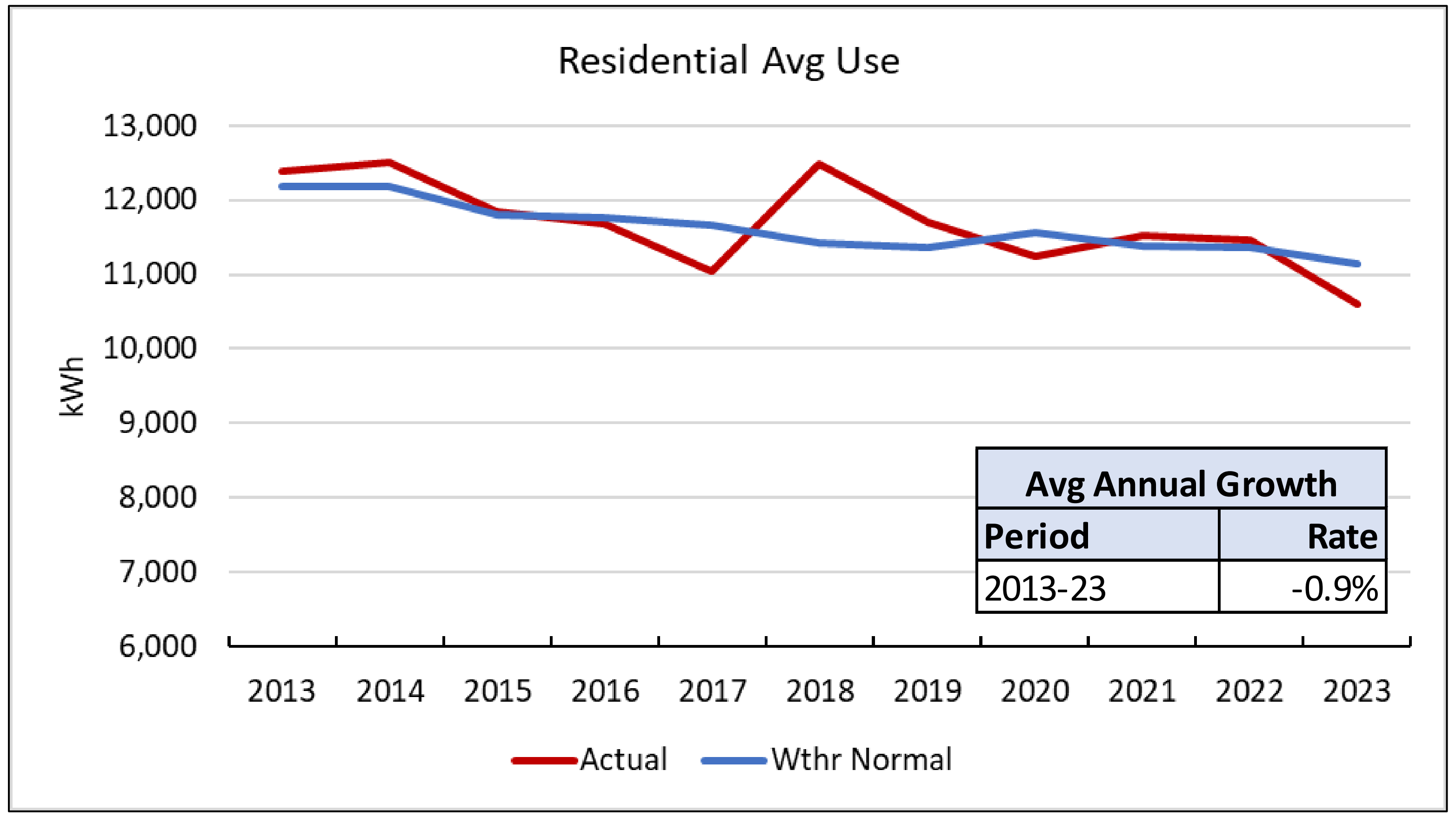
Residential customer and sales trends





→ Strong customer growth due to strong population and household formation in and around Indianapolis.

→ Continued average use decline due to federal codes and AES energy efficiency programs



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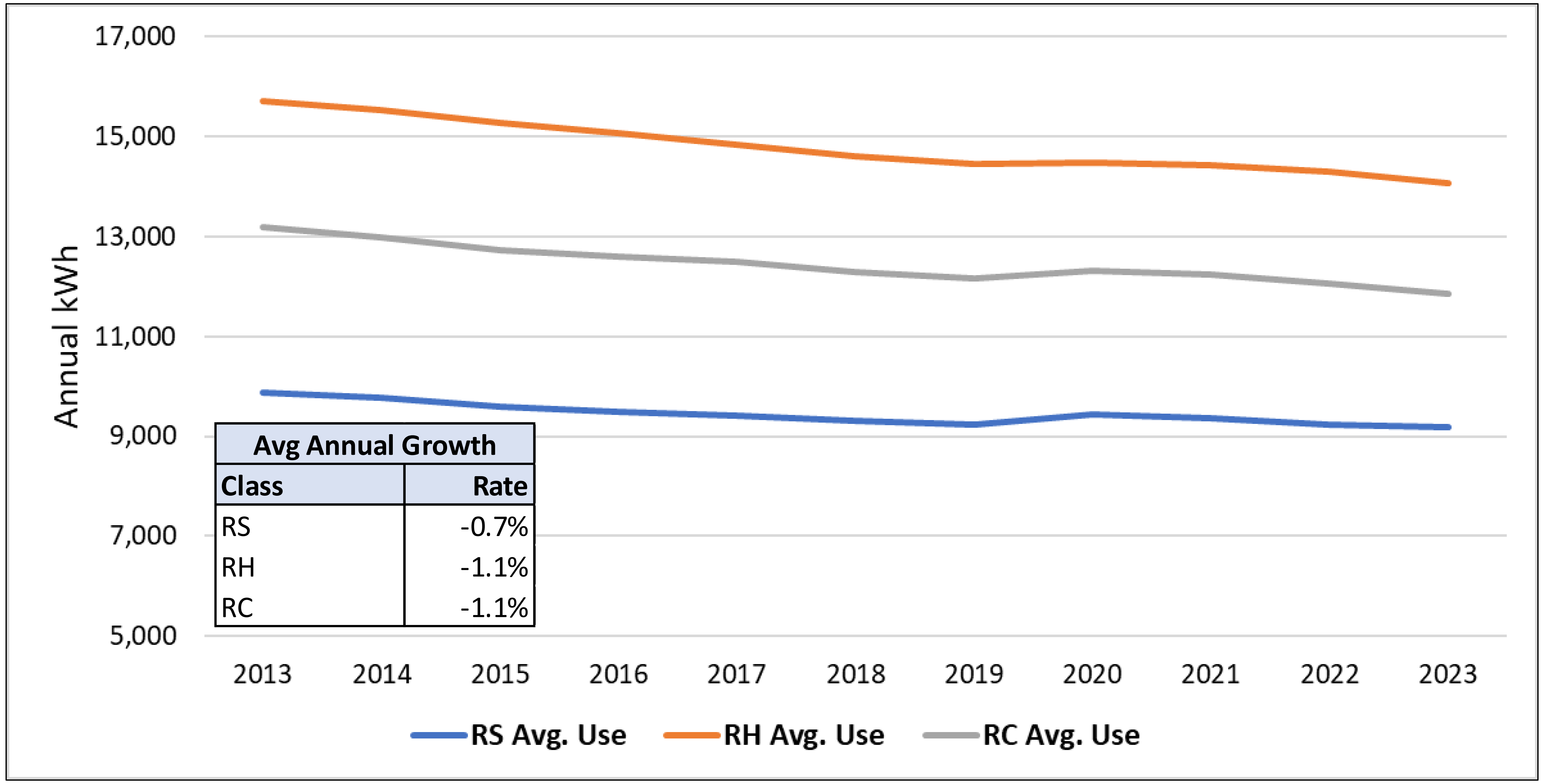
Residential tariff class average use

- → **Use per customer declining across all tariff classes**
- → Federal codes and standards
- → Increase in multi-family homes (decline in ft^2 per household)
- → AES Energy Efficiency (EE) Program Savings
- → Since the 2020 COVID induced increase, use per customer continues to decline



Avg Annual Growth	
Class	Rate
RS	-0.7%
RH	-1.1%
RC	-1.1%

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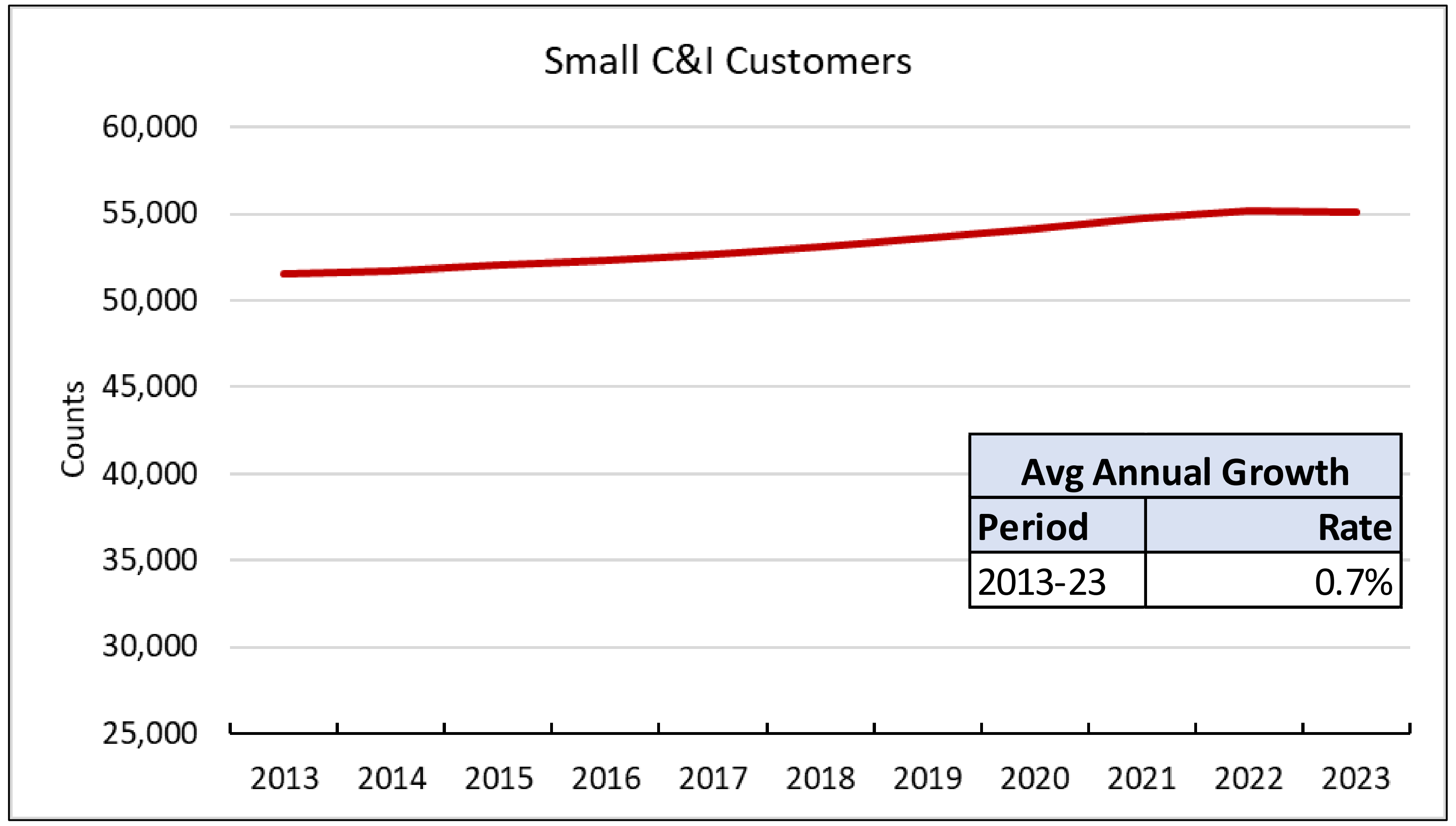
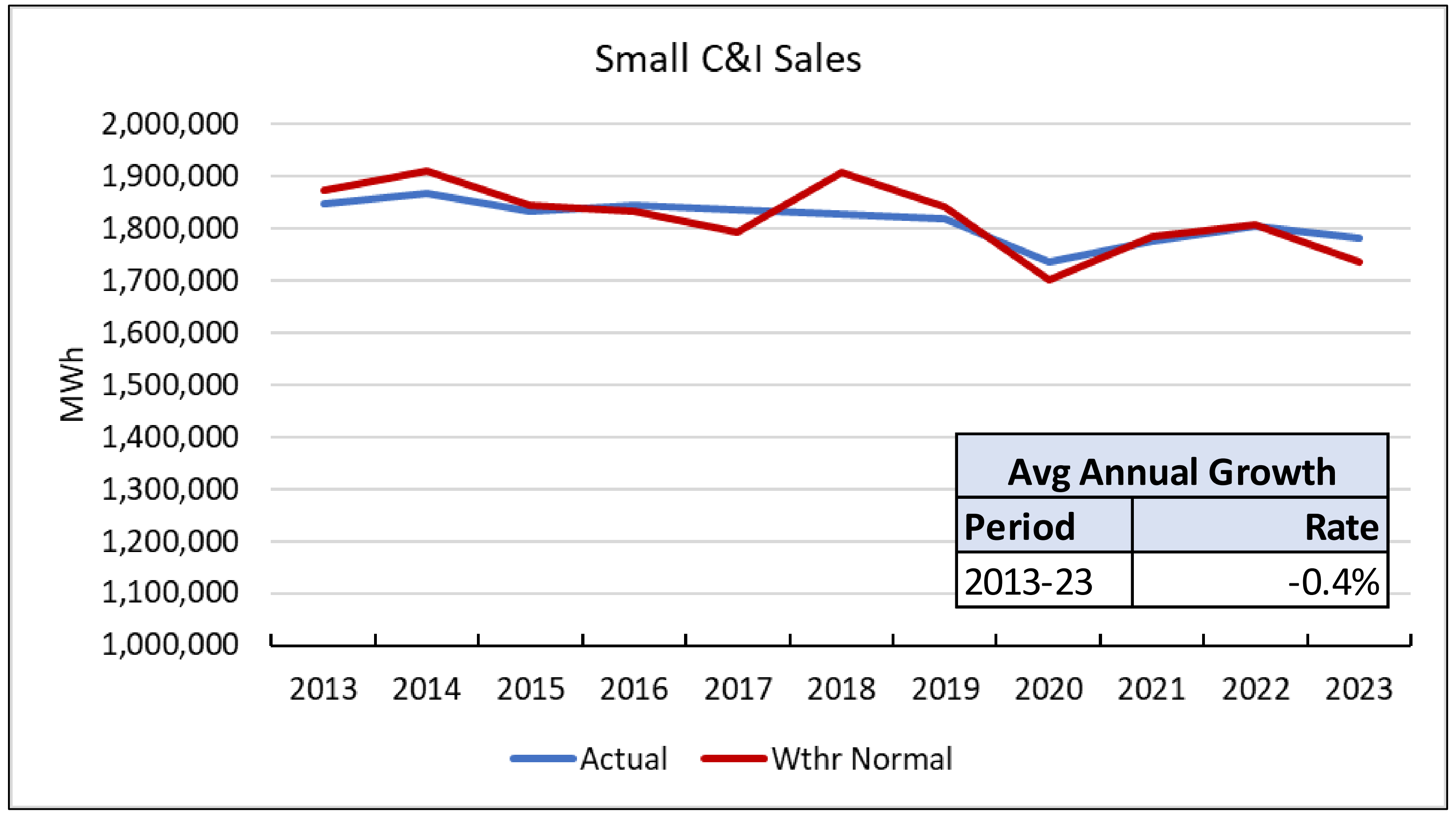
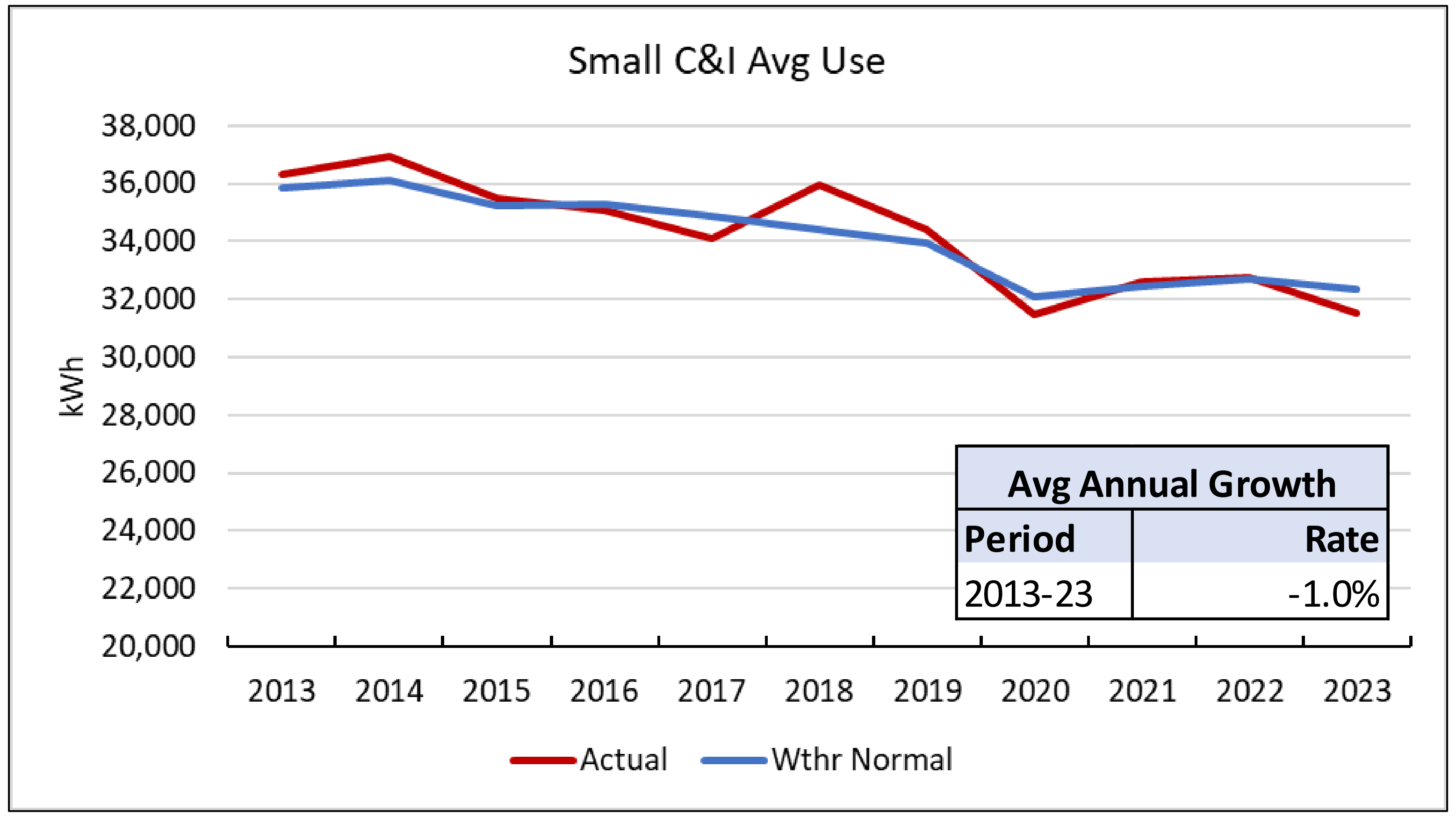
Small C&I sales and customer trends





- → Customer growth has slowed in the last 3 years
- → Like residential, downward pressure on usage due to federal codes and AES EE program savings
- → Sharp drop in 2020 sales due to COVID



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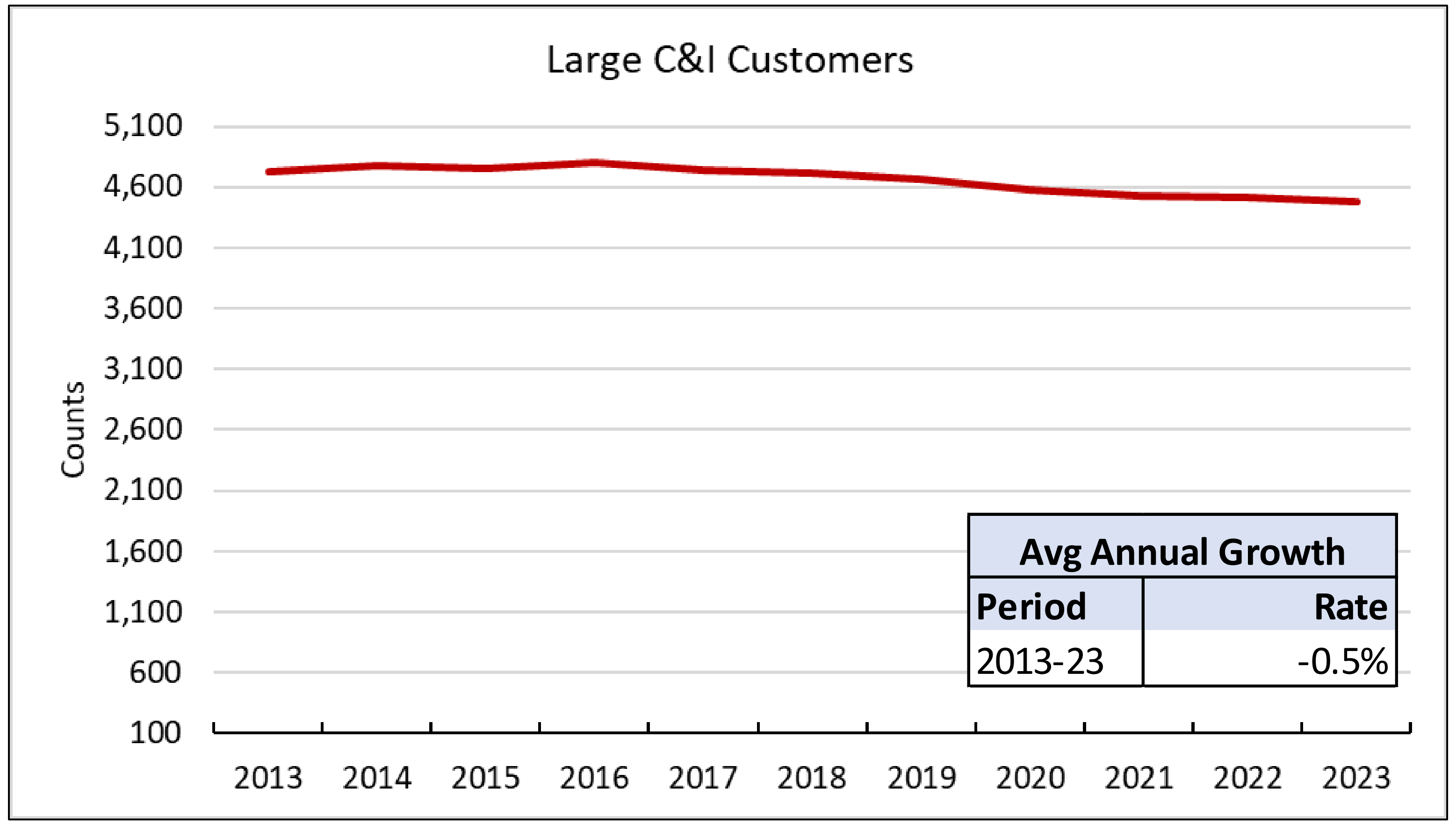
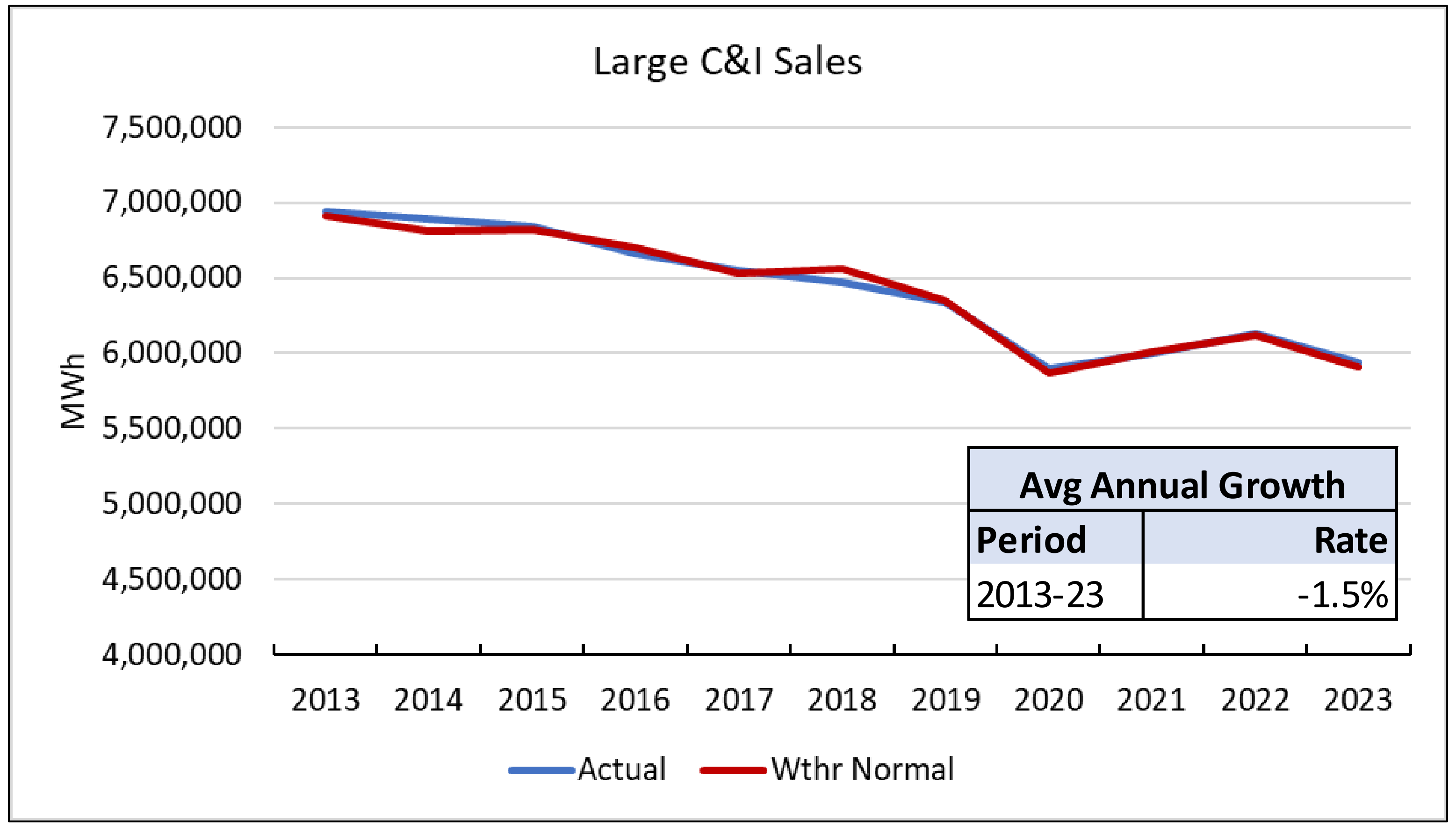
Large C&I sales and customer trends

→ Comprised of the SL, PH, PL, and High Load factor tariffs
→ SL tariff is made up of approximately 4,100 large commercial customers
→ The remaining customers are mainly industrial customers with a handful large load customers having a significant impact on sales and demand.
→ Sharp drop in 2020 sales due to COVID
→ Efficiency improvement due to AES EE program savings and customer run EE programs





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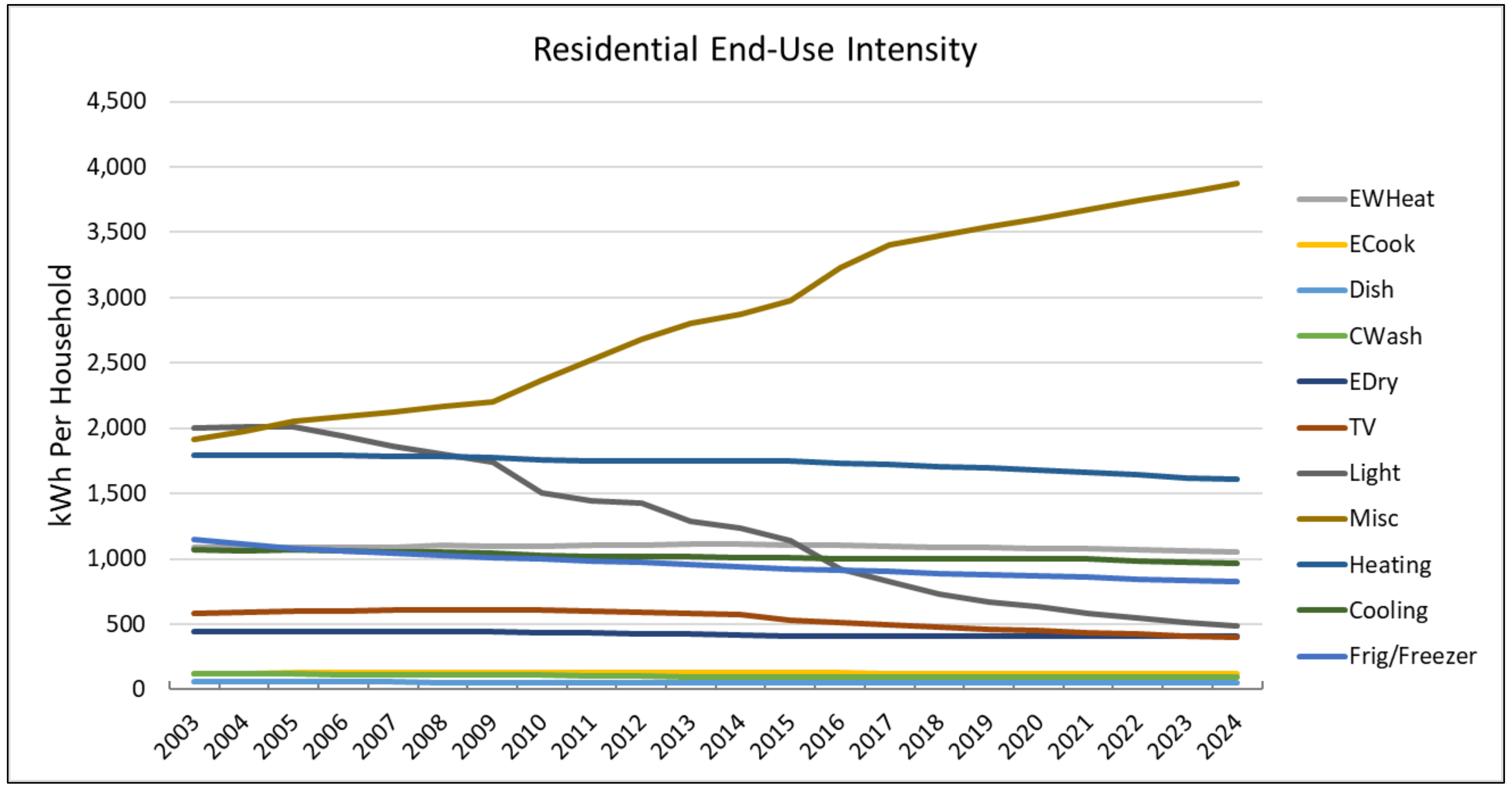
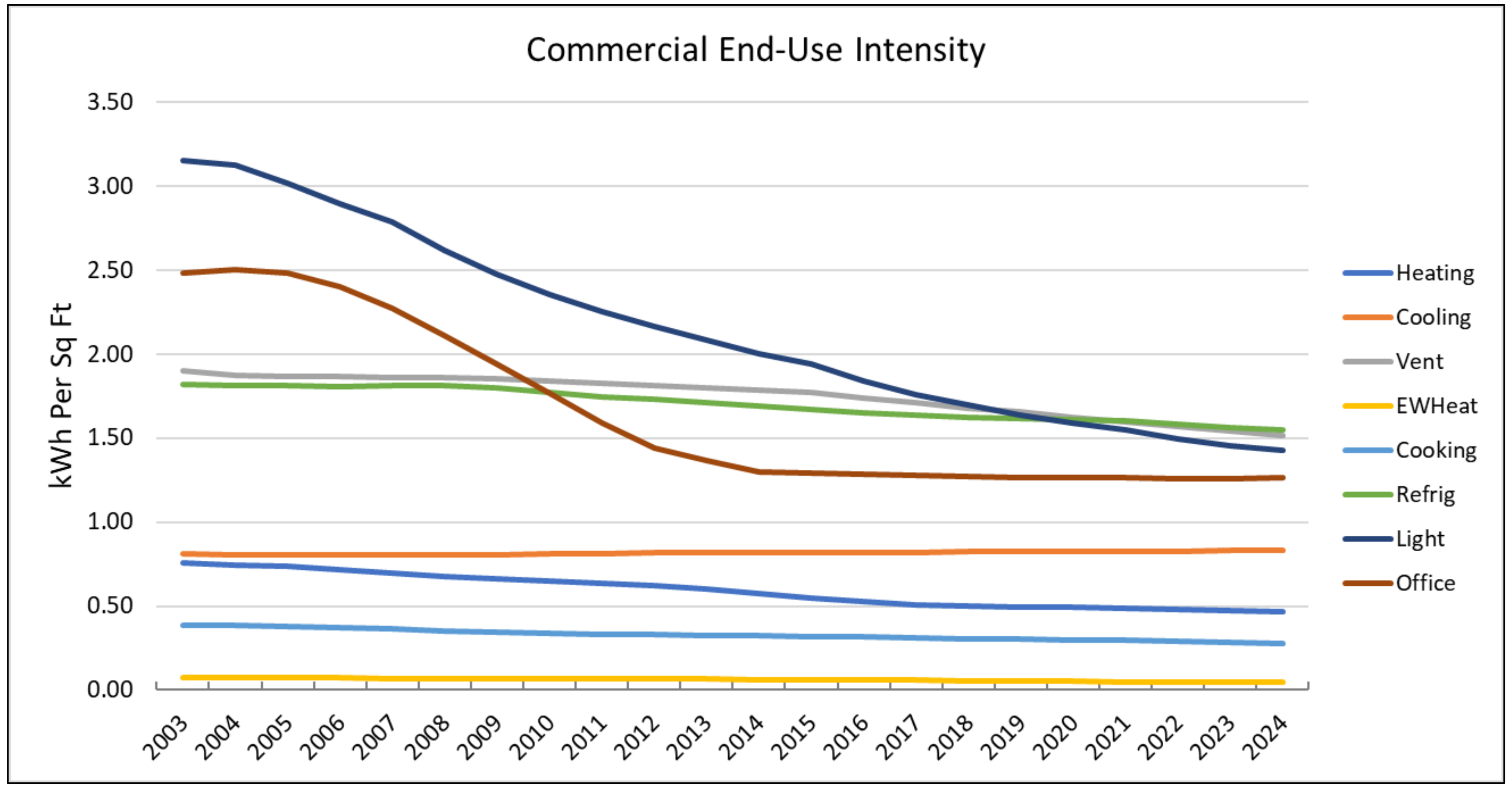
Why is residential and commercial use declining ?





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

→ Heating down 0.7%

→ 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 2.3%

→ Cooling up 0.2%

→ Base down 1.4%

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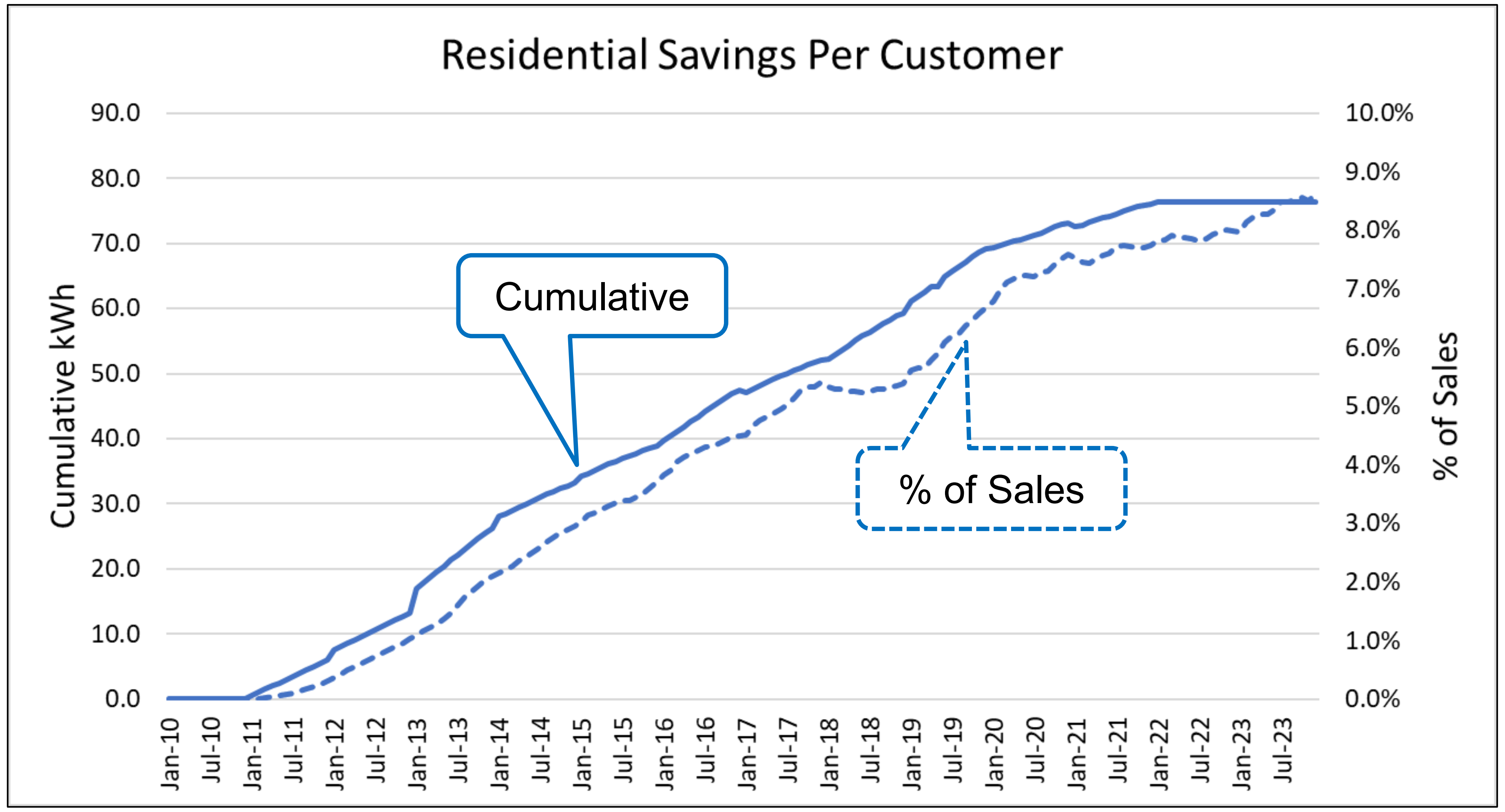
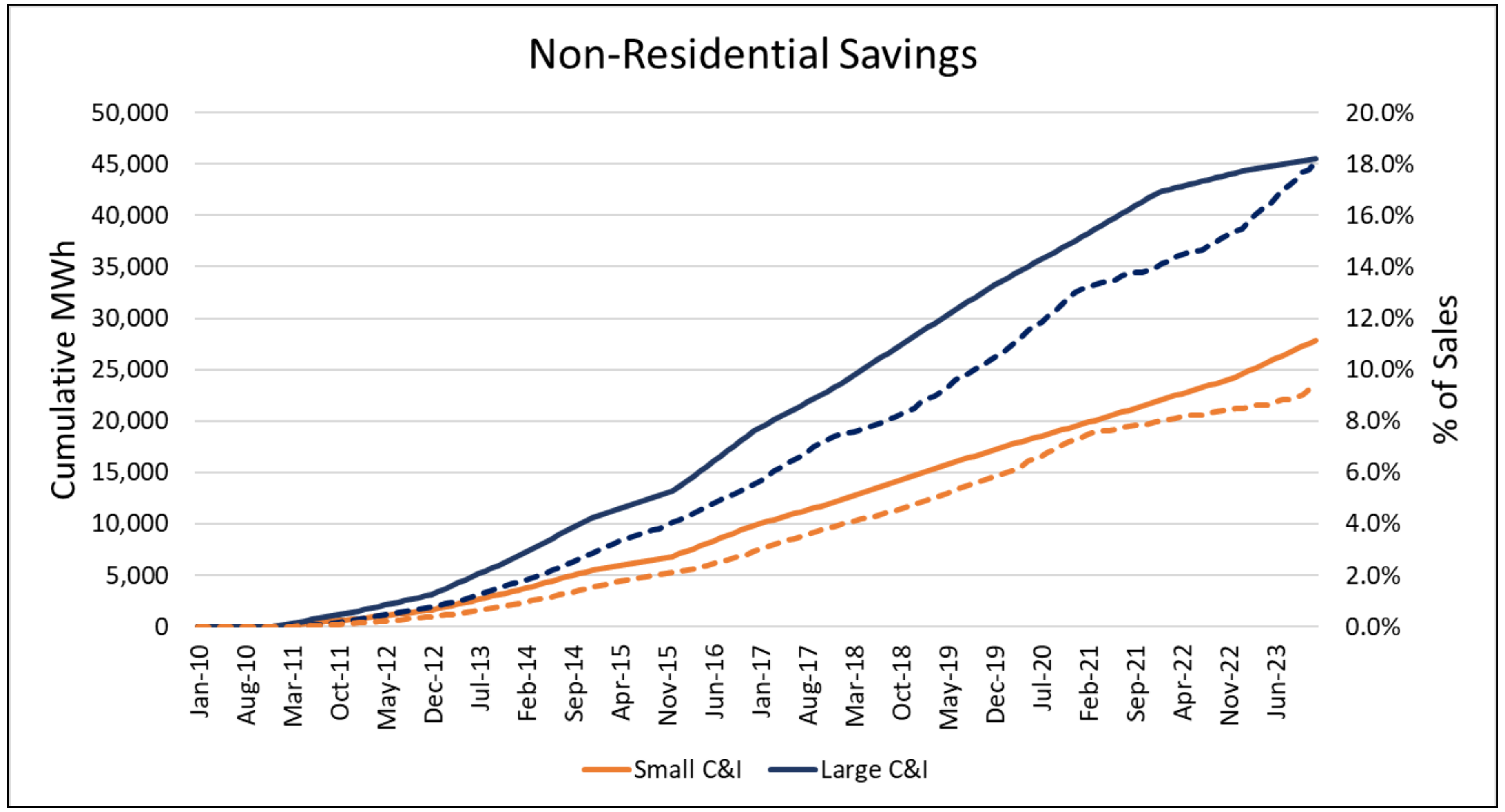
Significant energy efficiency (EE) program activity





Energy Efficiency programs have had a significant impact on sales

→ Reduces residential average use by nearly 9% over the last ten years

→ Reduces small C&I sales by 18%

→ Reduces large C&I sales by 9%

Modeling approach

Baseline modeling approach

- → Estimate tariff-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 Tariffs*
- → *Commercial Tariffs*
- → *Industrial Tariffs*
- → *Other Tariffs*

Economic drivers →
End-use standards →
Weather conditions →
Electric prices →
EE programs →

End-Use and Customer Class Energy Forecast

↓

Monthly peak model driven by end-use energy forecasts

System hourly load data →
Peak normal weather →
End-use profiles →

System Peak Forecast

- → The Baseline forecast excludes behind the meter solar, electric vehicle loads, and future EE program savings
- → Solar and electric vehicles will be added to forecast depending on IRP scenario
- → EE program savings are selectable in the IRP model and, therefore, need to be removed from the IRP load forecasts.

Rate class models

→ Models estimated by tariff class billed sales and customer data

→ Monthly model, estimated for the period January 2011 to Sept 2024*

- → **5 residential customer classes**
  - RS, RC, RH, CR, Residential APL (automatic protective lighting)
  - Average use and customer models
- → **6 small C&I customer classes**
  - SS, SH, SE, CB, UW, Commercial APL (automatic protective lighting)
  - Sales and customer models
- → **7 large C&I industrial customer classes**
  - SL, PL, PH, HL1, HL2, HL3, Industrial APL (automatic protective lighting)
  - Sales and customer models

→ Structured end-use models that incorporate end-use intensities as well as economic drivers

*High load factor and lighting tariff models are estimated starting in 2018

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Statistically adjusted end-use approach (SAE)

- Objective:
  - Develop an econometric approach that incorporates the best characteristics of an econometric and end-use modeling framework
- Accounts For:
  - Economic impacts (e.g., household income and size, price impacts)
  - End-Use Structural changes (e.g., saturation and efficiency trends, housing square footage, thermal shell integrity improvements)
  - Weather impacts
- Statistical Framework:
  - Ideally, one model for budget and long-term forecasting

Econometric Component

End Use Component

Statistical step to "Adjust" components

Residential SAE average use model

End Use Stock	→ **Thermal Efficiency** → **Home Square Footage** → **AC Saturation** → Central → Heat Pump → Room AC → **AC Efficiency**	→ **Thermal Efficiency** → **Home Square Footage** → **Heating Saturation** → Resistance → Heat Pump → **Heating Efficiency**	→ **Saturation Levels** → **Water Heat** → **Appliances** → Lighting → Plug Loads → **Appliance Efficiency**	
Utilization	→ **Real Income** → **Price** → **Household Size** → **Cooling Degree Days**	→ **Real Income** → **Price** → **Household Size** → **Heating Degree Days**	→ **Real Income** → **Price** → **Household Size** → **Billing Days**	
Result	**Cooling Use** +	**Heating Use** +	**Other Use** =	**Monthly Average Use**

Tariff Level
AES Energy Efficiency Savings

$$AvgUse_m = a + b_c \times XCool_m + b_h \times XHeat_m + b_o \times XOther_m + b_d \times EEm + e_m$$

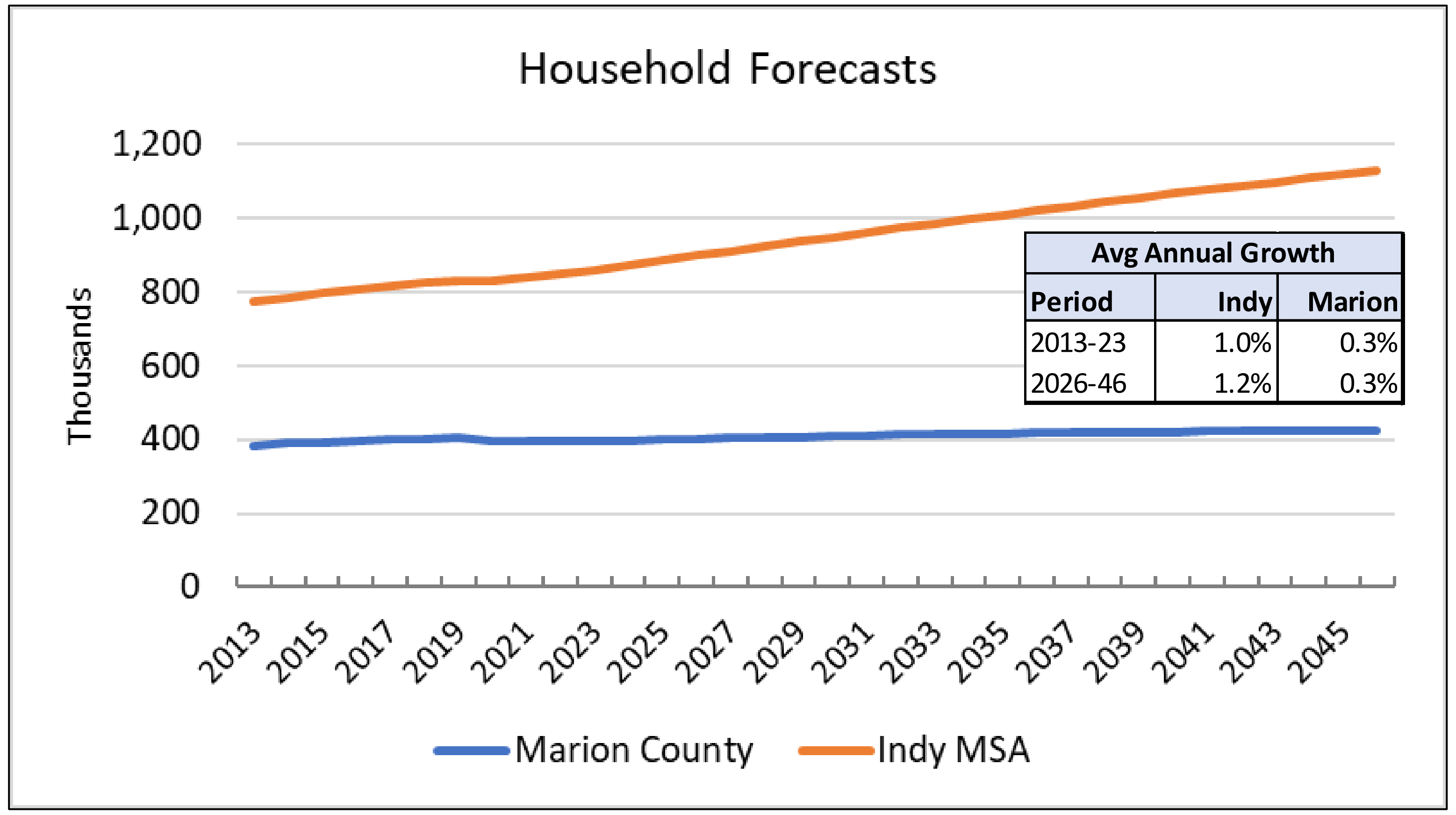
Commercial SAE sales model

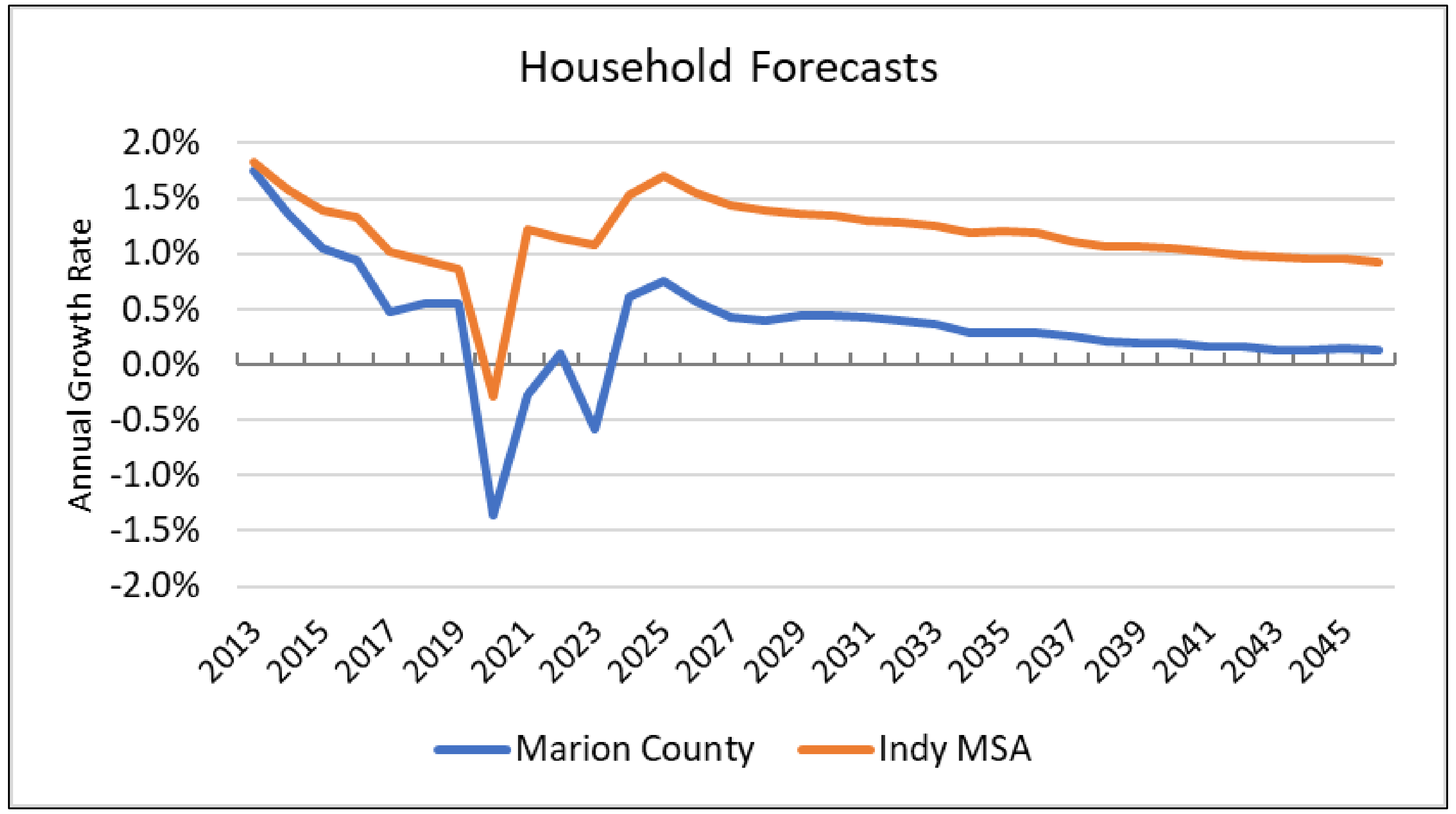
End Use Stock	**Cooling Intensity (kWh/ft^2)** → Cooling Saturation → Cooling Efficiency	**Heating Intensity (kWh/ ft^2)** → Heating Saturation → Heating Efficiency	**Base Intensity (kWh/ ft^2)** → Lighting → Office Equipment → Ventilation → Water Heating → Misc.	
Utilization	→ **Real Output** → **Employment** → **Population** → **Cooling Degree Days**	→ **Real Output** → **Employment** → **Population** → **Heating Degree Days**	→ **Real Output** → **Employment** → **Population** → **Billing Days**	
Result	**Cooling** ➕	**Heating** ➕	**Base Load** =	**Monthly Total Sales**

Tariff Level
AES Energy Efficiency Savings

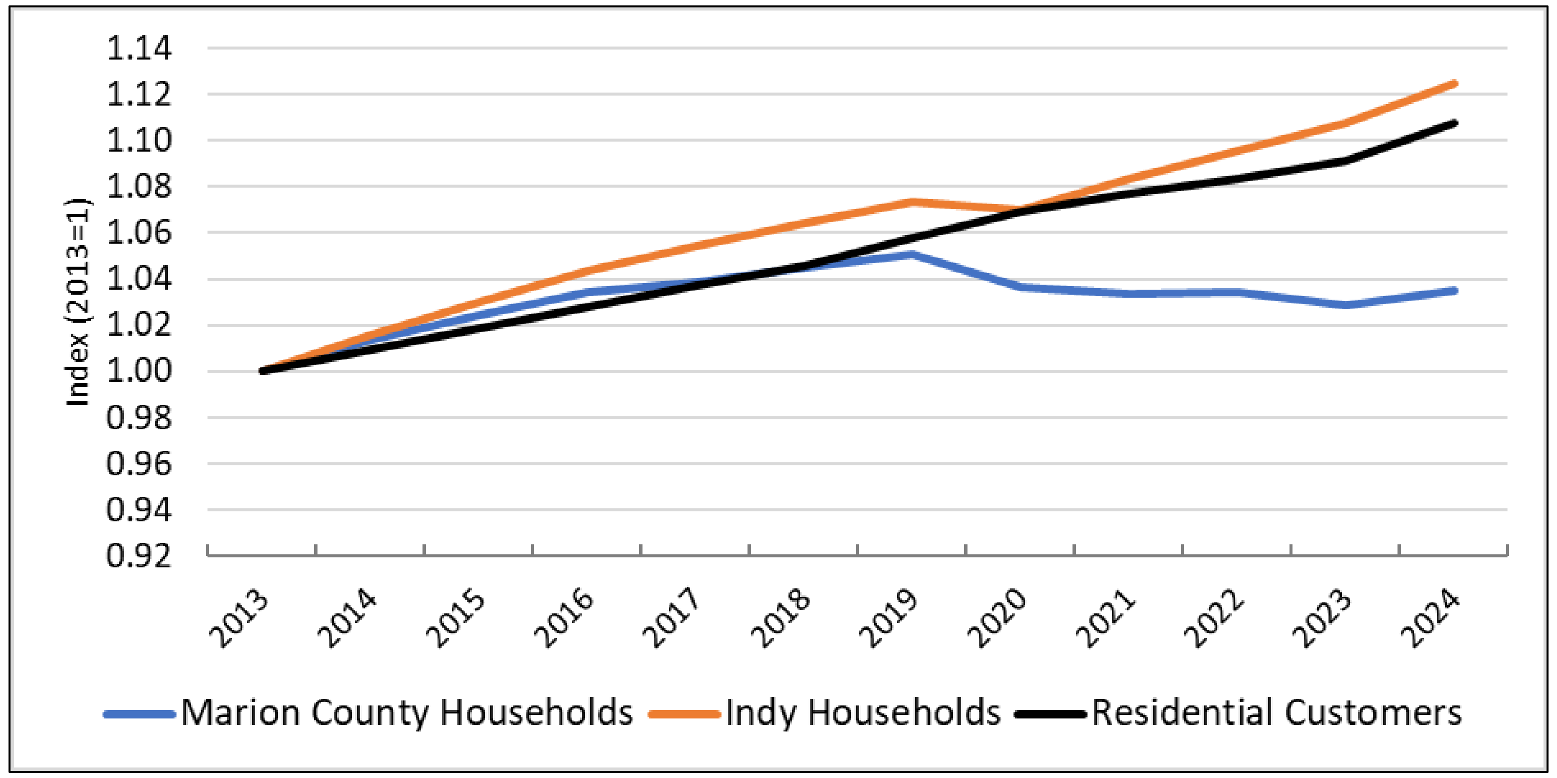
$$MWh_m = a + b_c \times XCool_m + b_h \times XHeat_m + b_o \times XOther_m + b_d \times EEm + e_m$$

Residential customer drivers





- → Moody Analytics (October 2024), economic forecast for Marion county and Indianapolis MSA.
- → Indy households are more highly correlated with AES residential customers than Marion county.



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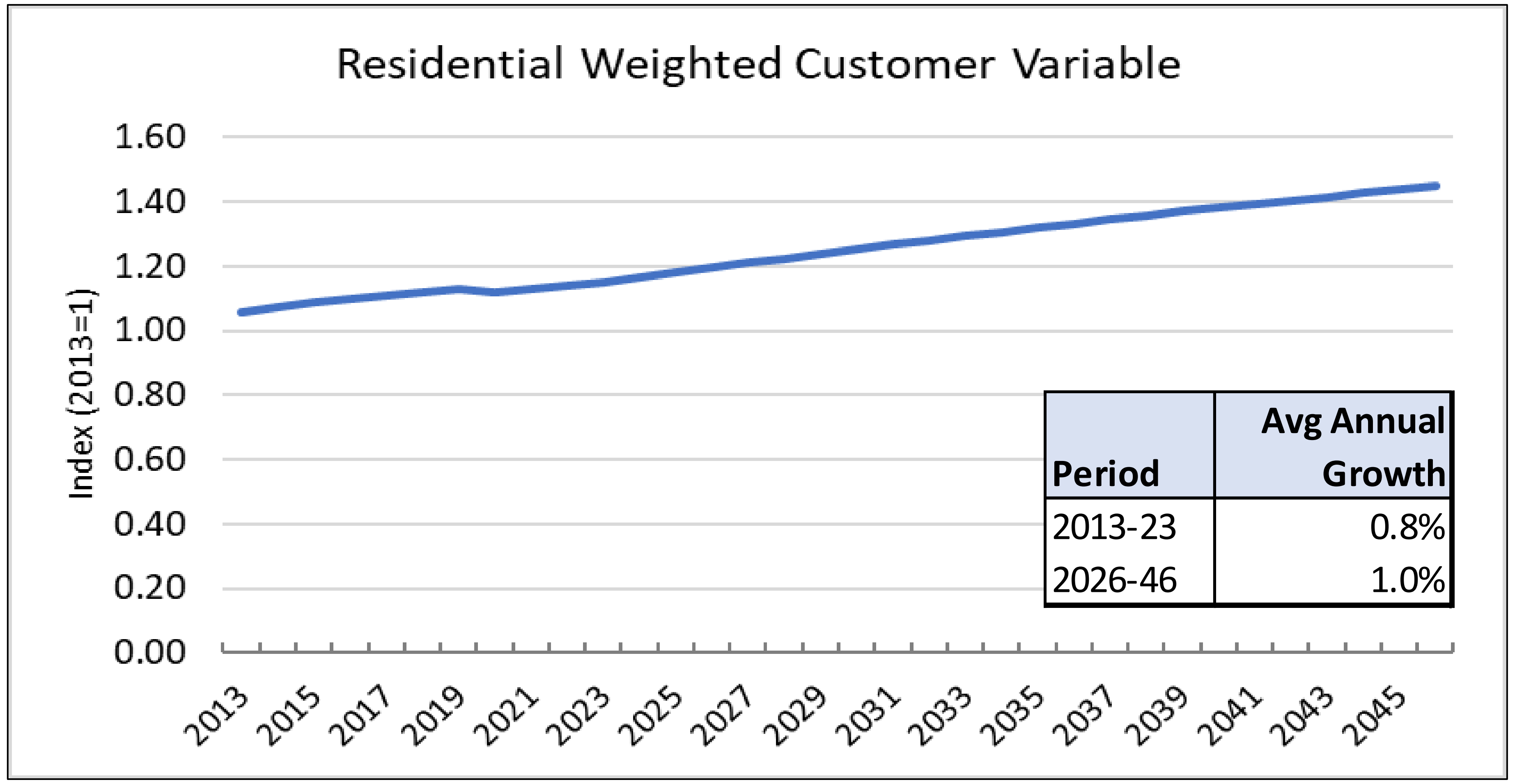
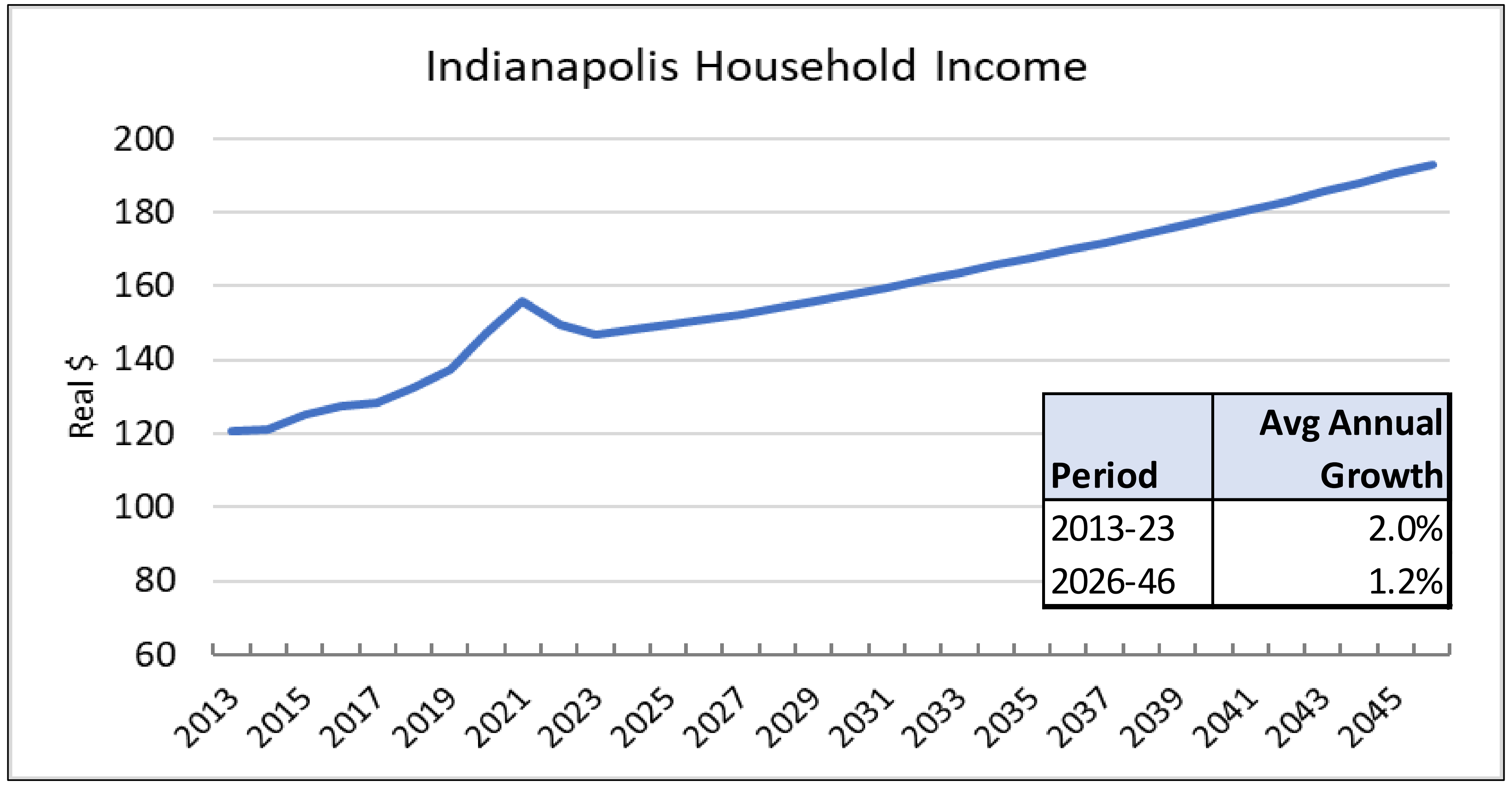
Residential economic drivers





→ Weighted household variable drive the residential customer forecast. 75% weight on Indy household variable and 25% on Marion county

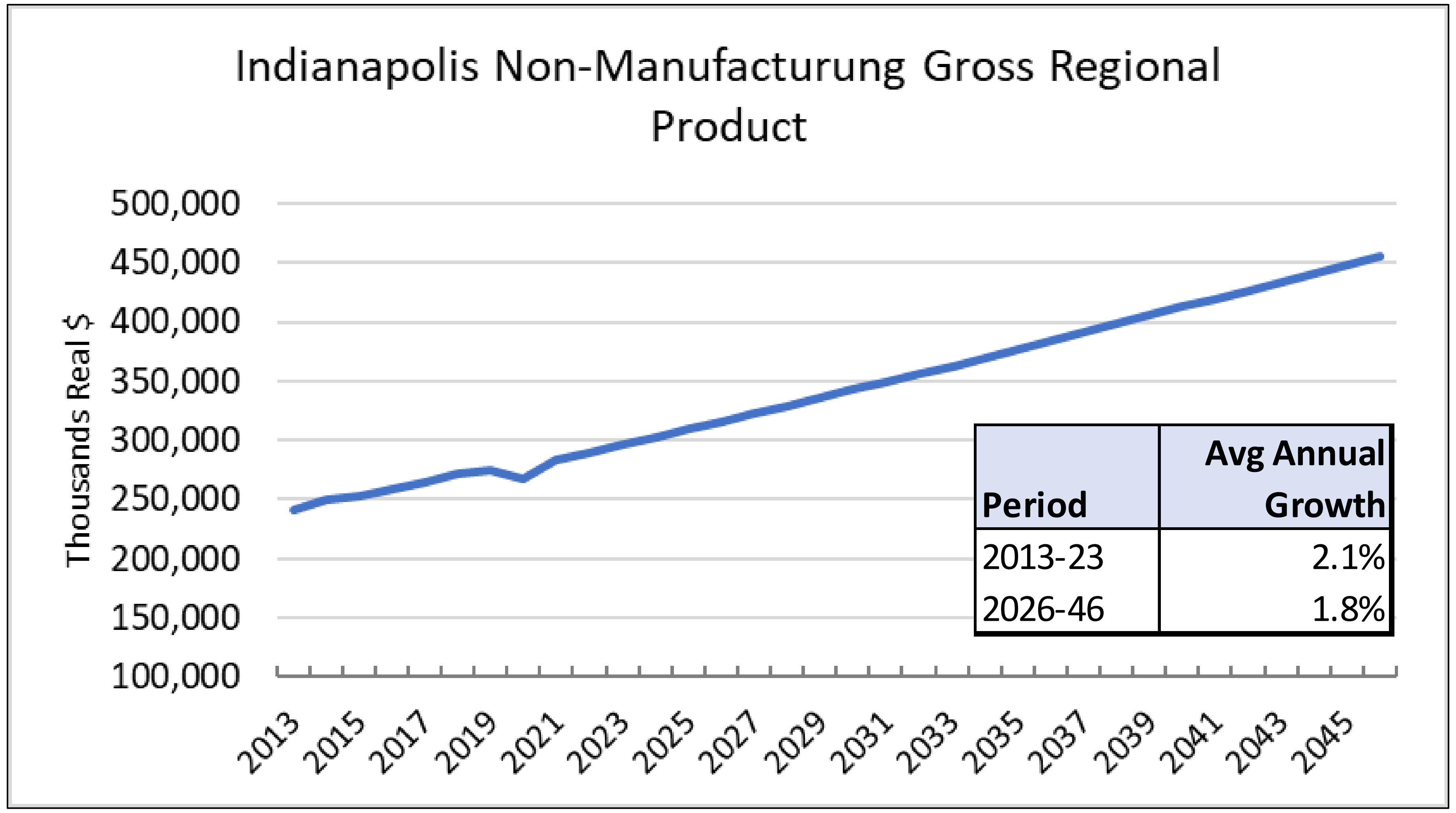
→ Expected household growth is slightly stronger than the last ten years

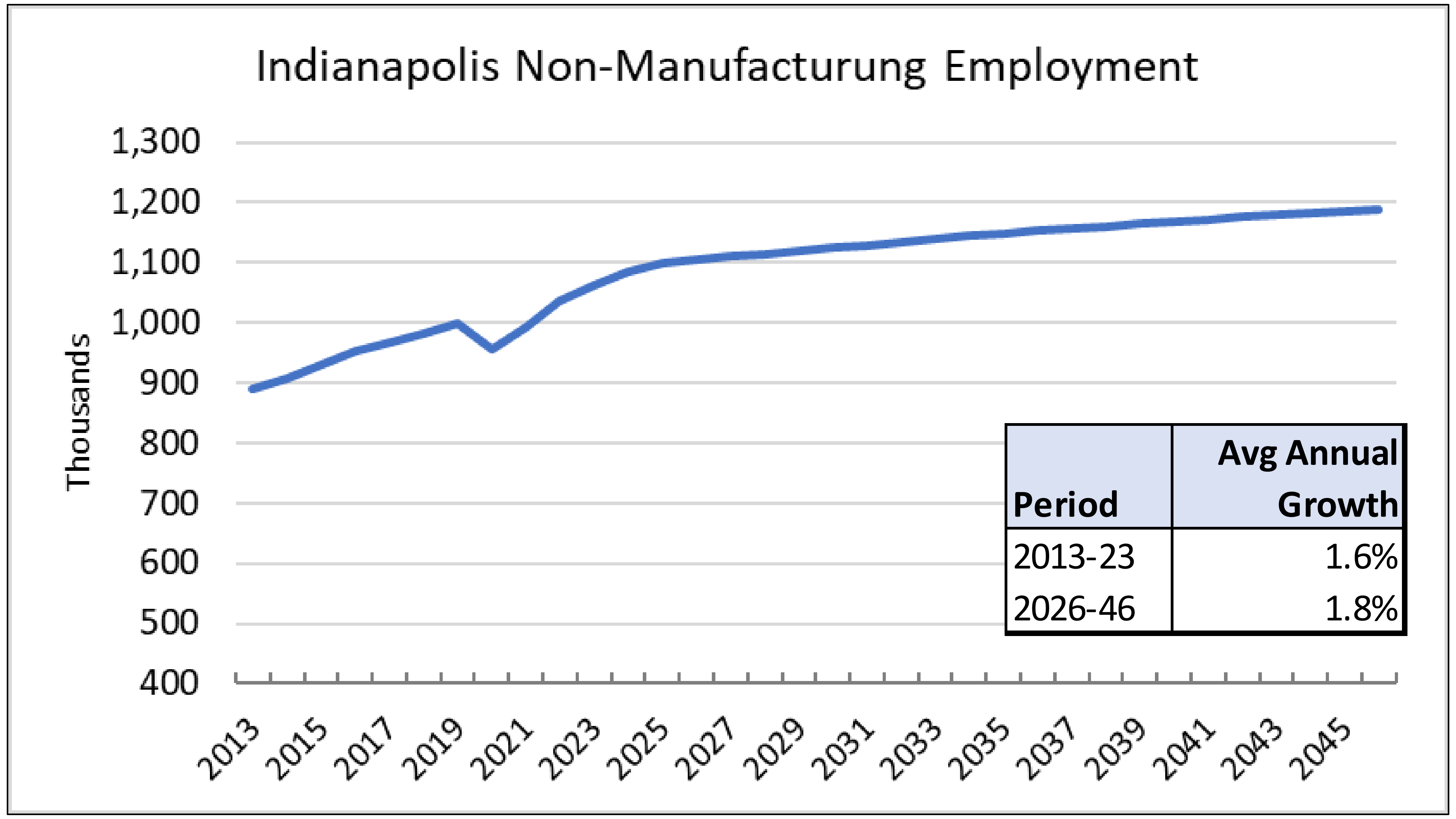
→ Household income influences customer use

→ Imposed income elasticity of 0.2

Indiana

C&I economic drivers





→ Output and employment concepts are weighted into a single economic variable.

→ Weights vary by tariff class

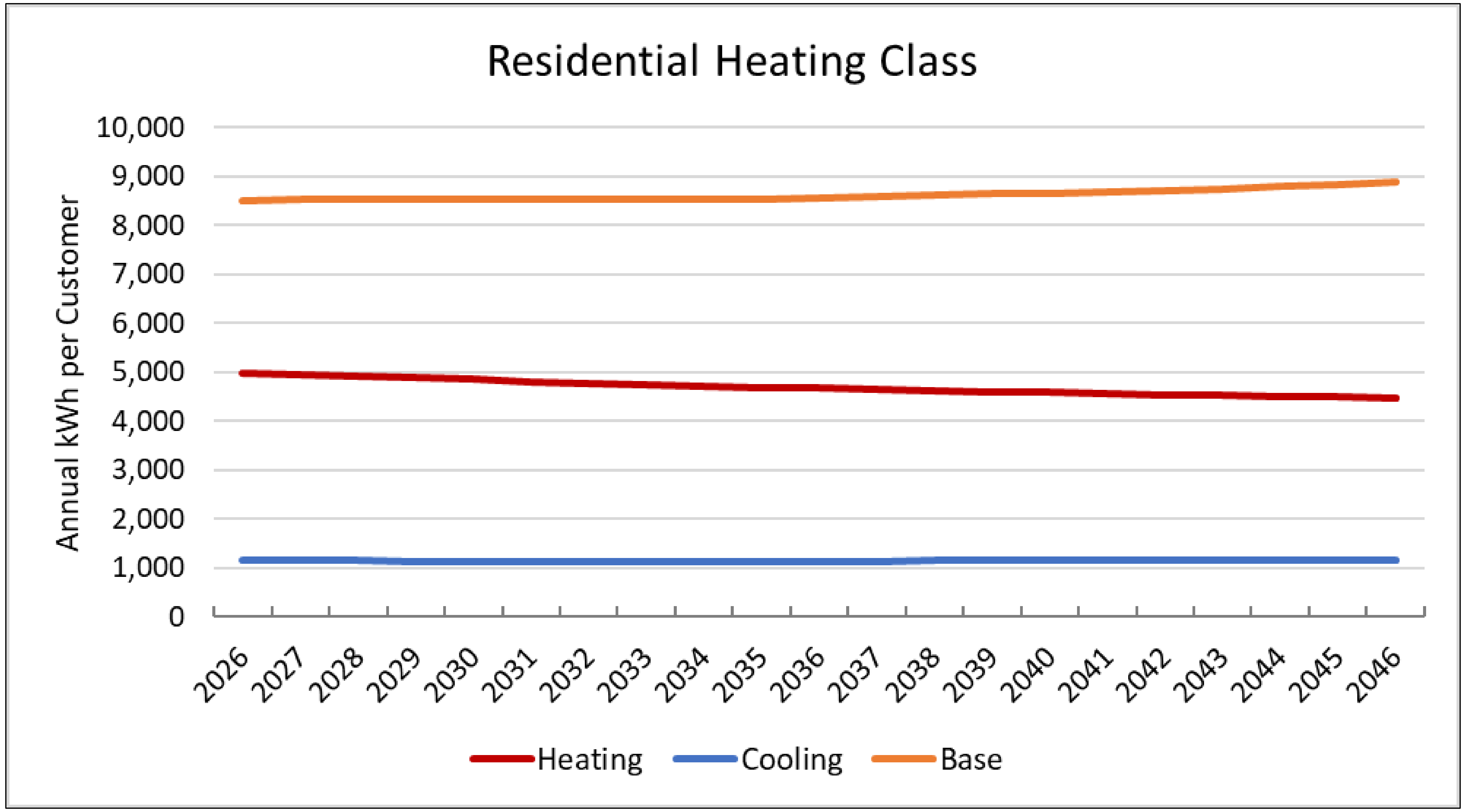
→ Slower employment growth in the out years. Implies higher long-term productivity.

AES Indiana

Residential end-use intensity projections

→ End-Use intensities based on end-use saturation and average stock efficiency derived from Energy Information Administration's (EIA) 2023 Annual Energy Outlook (AEO) for East North Central Census Division.

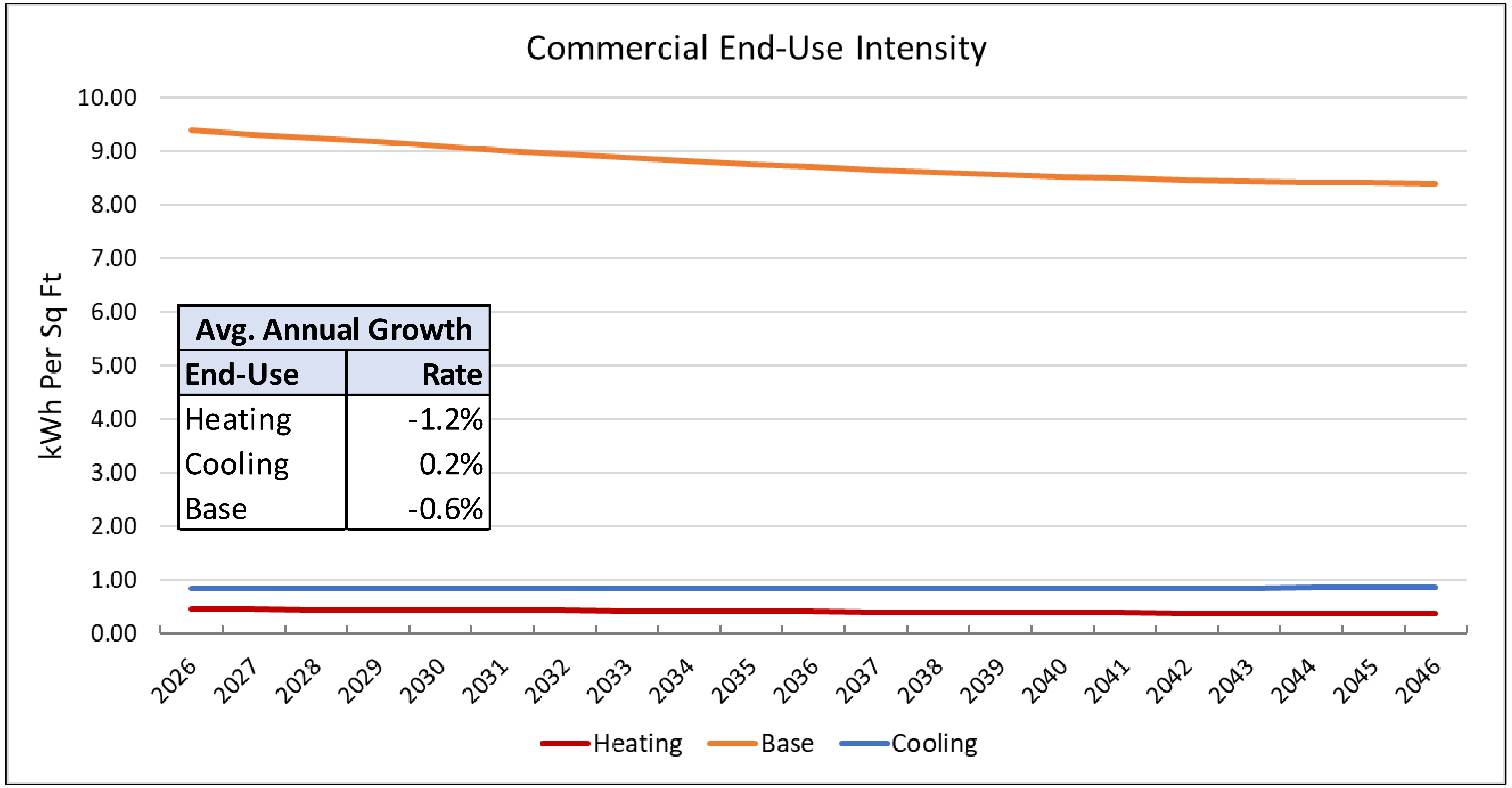
→ Residential calibrated to AES service area based on historical appliance saturation surveys and DSM potential study.



Avg. Annual Growth	
End-Use	**Rate**
Heating	-0.5%
Cooling	0.0%
Base	0.2%

Commercial end-use intensity projections

- → End-Use intensities (kWh per square ft) projected for 9 end-uses and 11 building types
- → Derived from EIA's 2023 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



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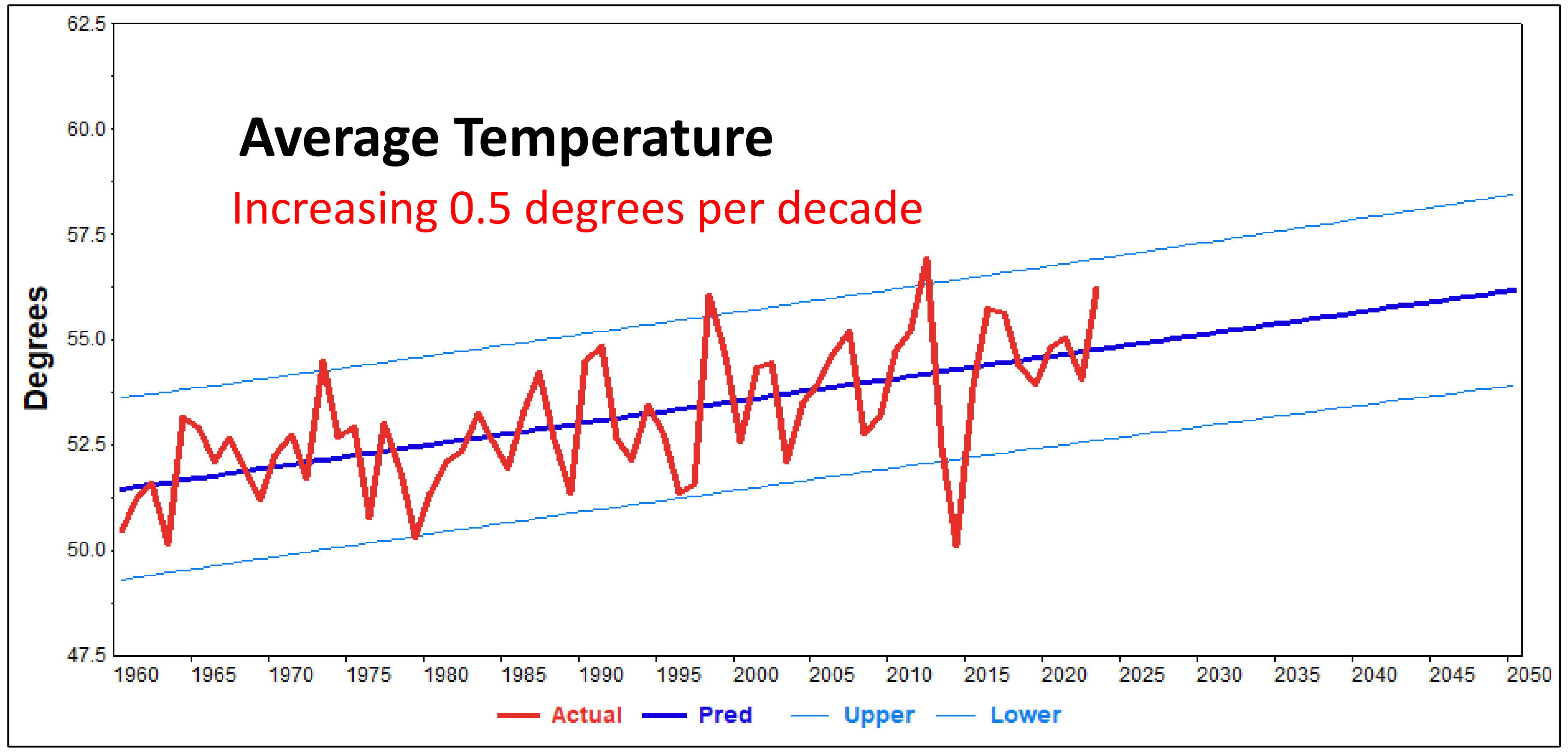
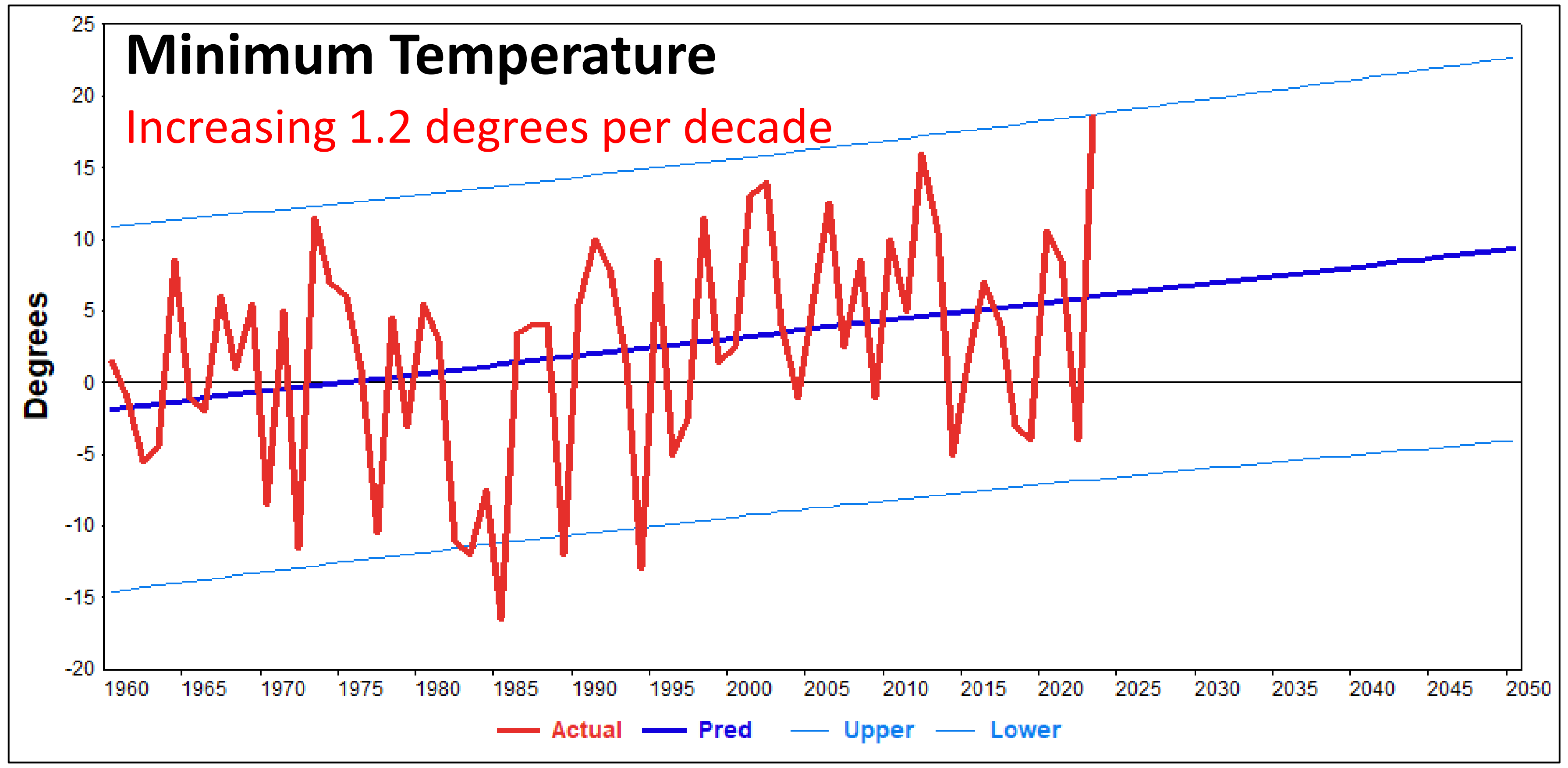
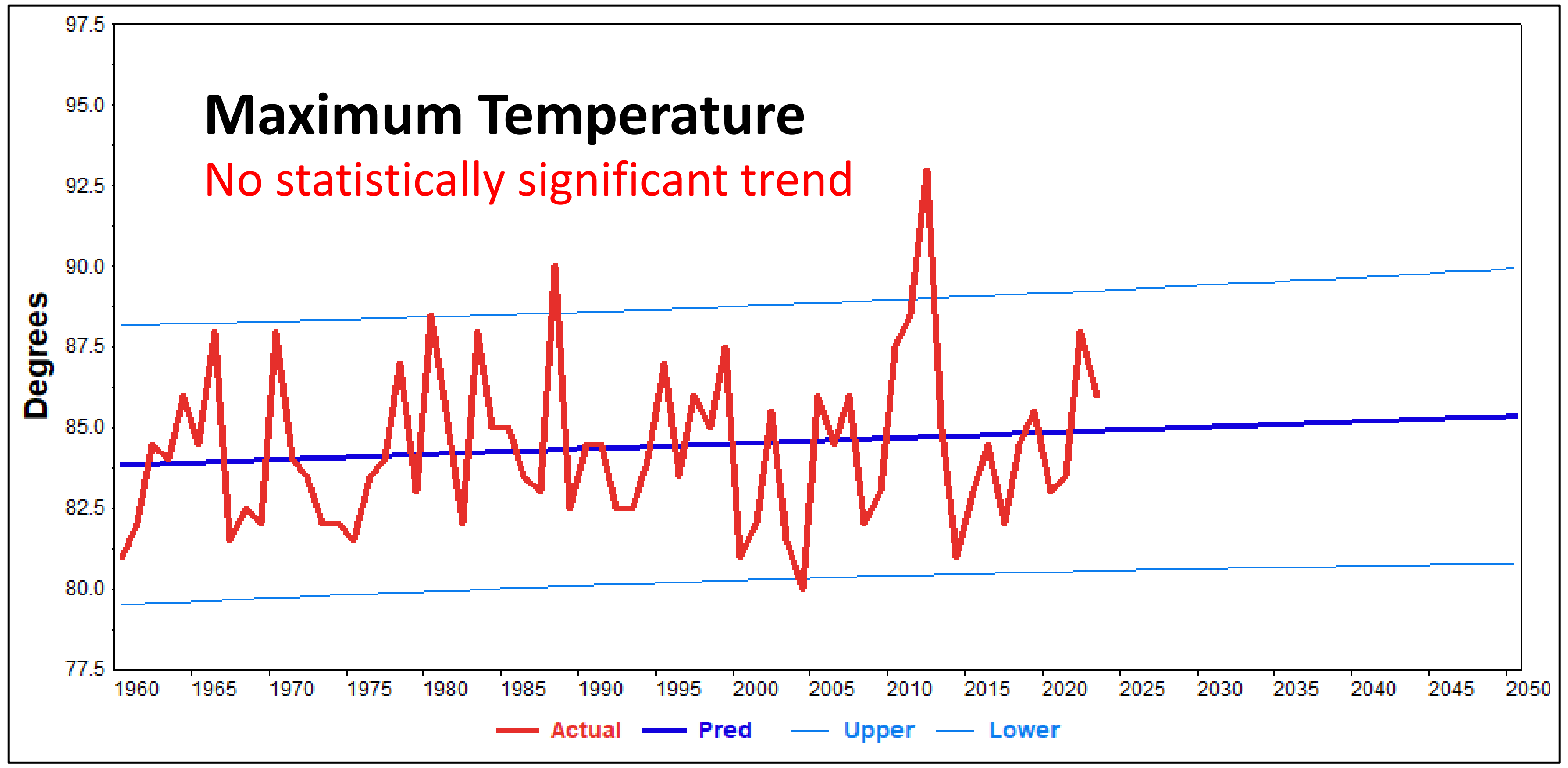
Temperature trends

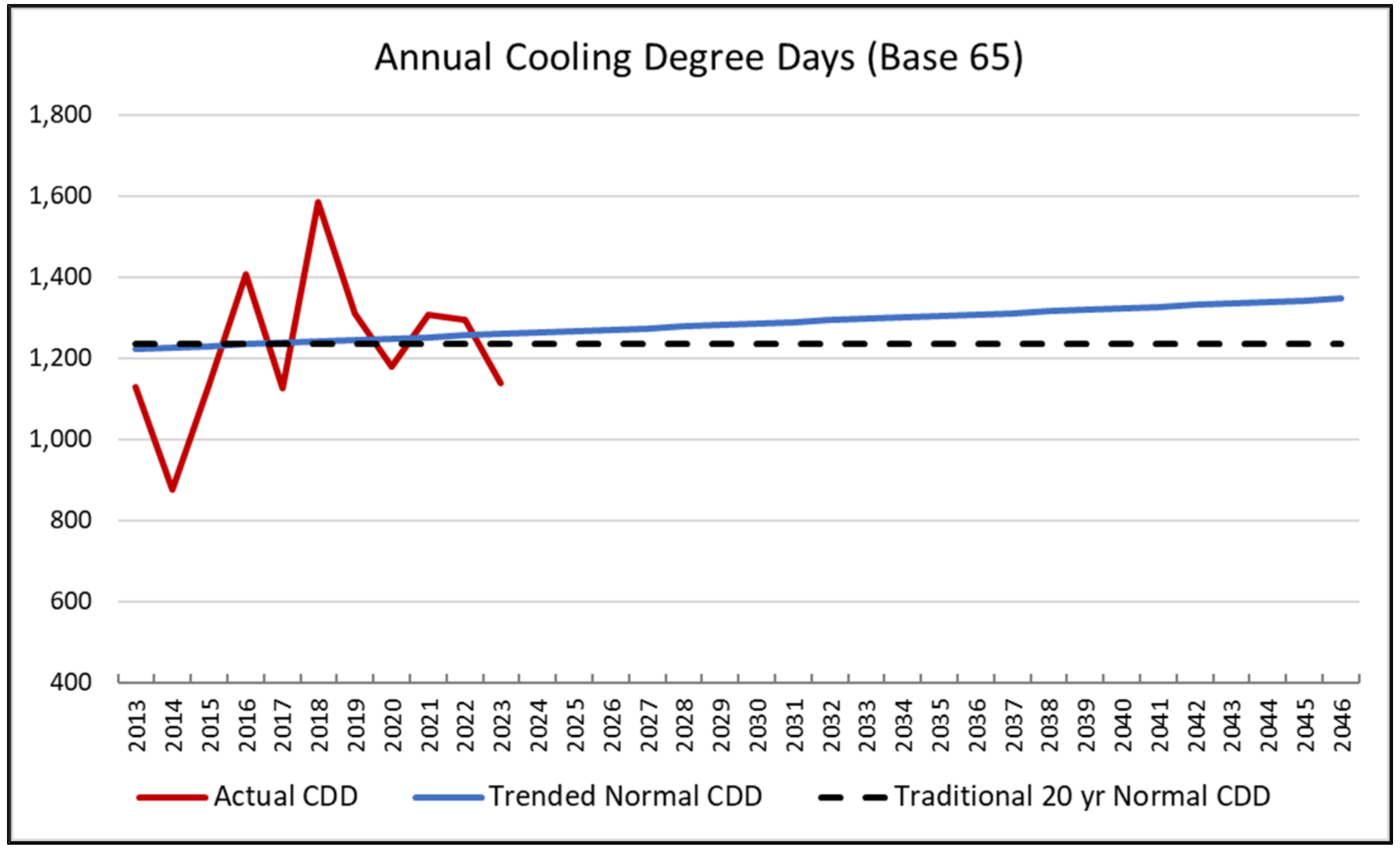


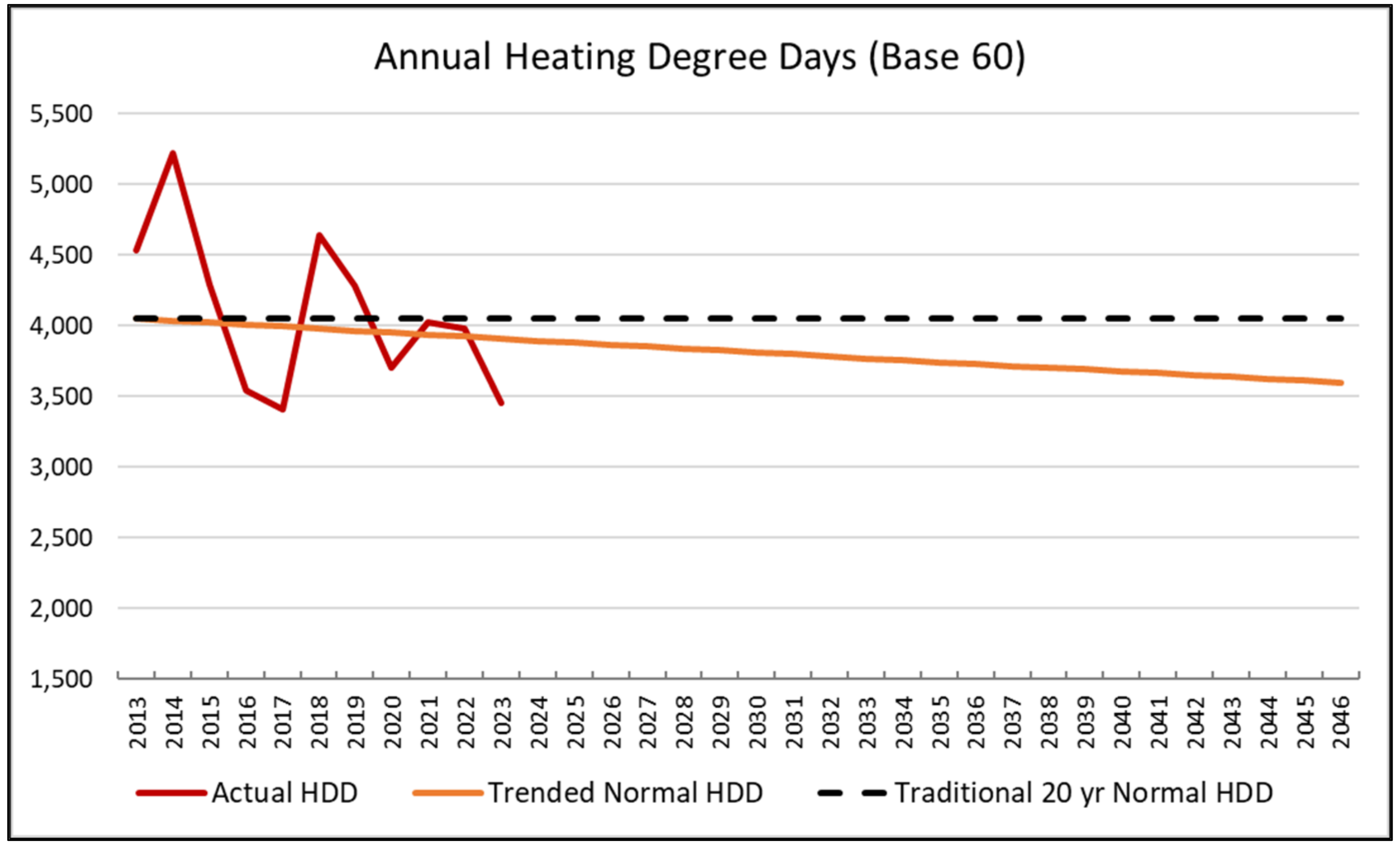


- → Average annual temperature is increasing .05 degrees per year or 0.5 degrees per decade
- → Consistent with temperature trends across the country 0.4 degrees to 1.2 degrees per decade
- → Minimum temperature increasing twice as fast as the average temperature. No increase in the maximum temperature



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

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Non-SAE tariff rate class models

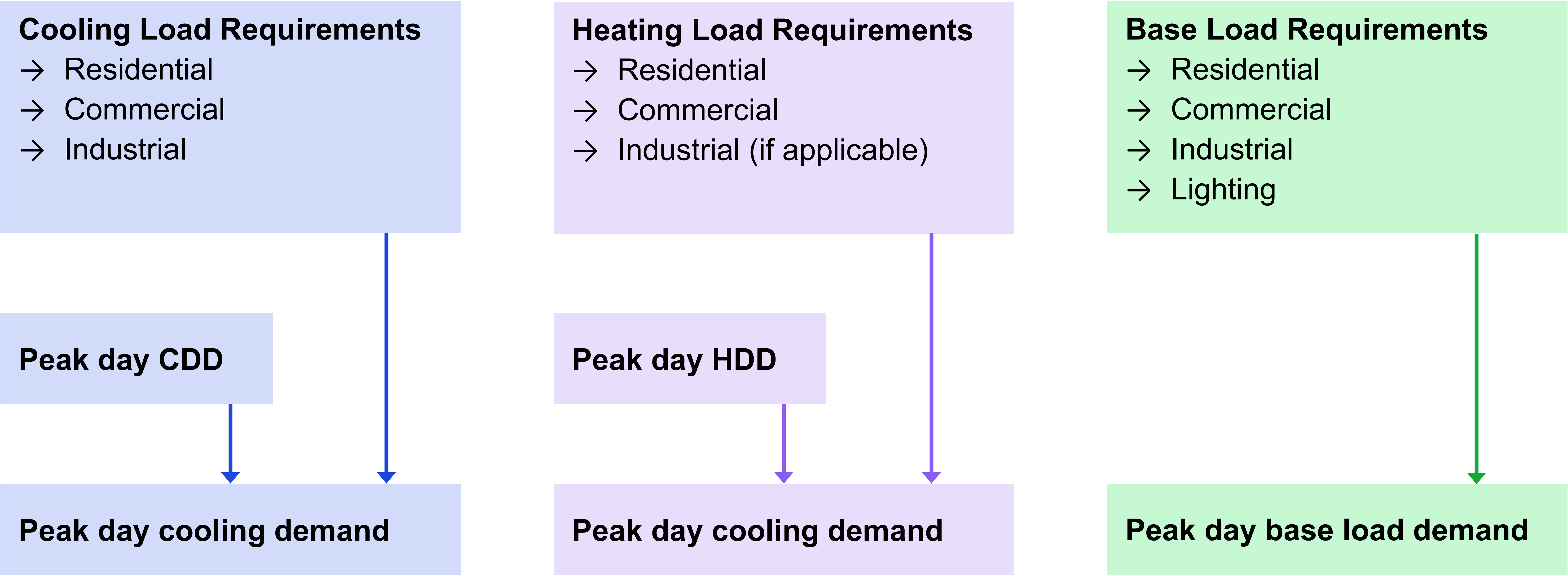
- Lighting and large industrial class models estimated using simple econometric models
  - Weather variables
  - Monthly binaries
  - Shift variables to account for changes in sales, such as LED replacement in street lighting

- Large industrial classes include out-of-model adjustments to account for known expansion and contractions.
  - These adjustments are based on correspondence between AES account reps and individual large customers

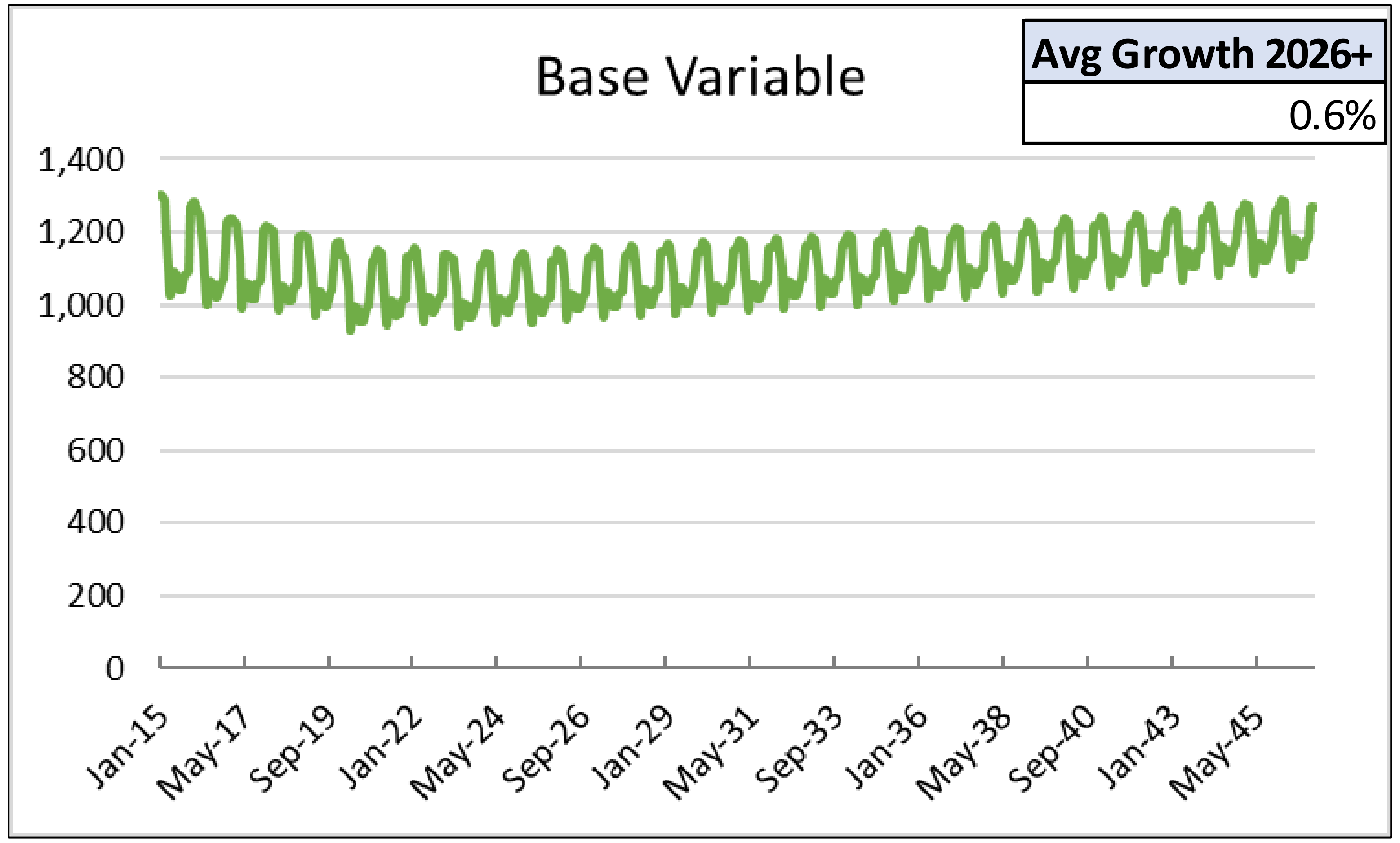
AES Indiana

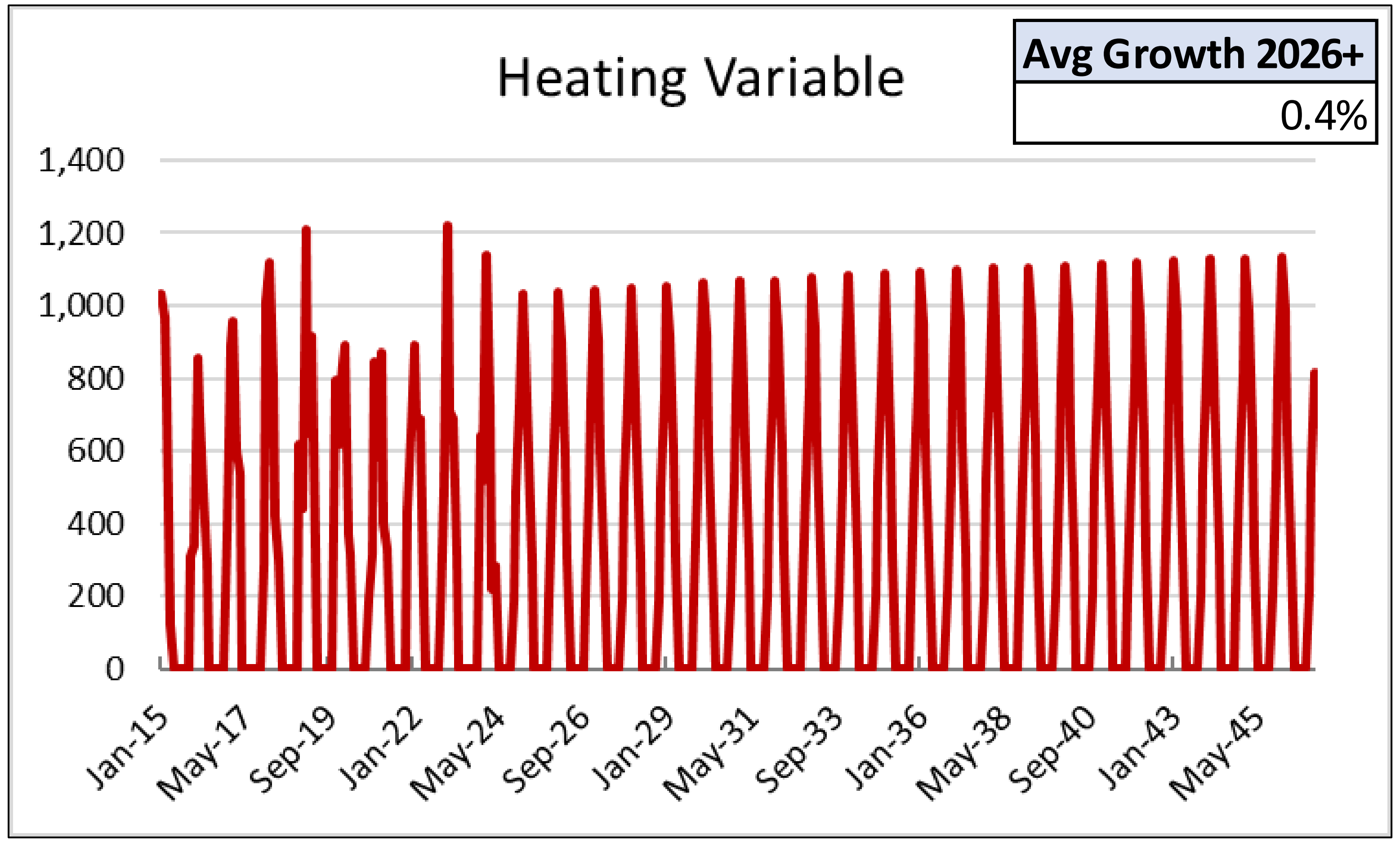
Peak model

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

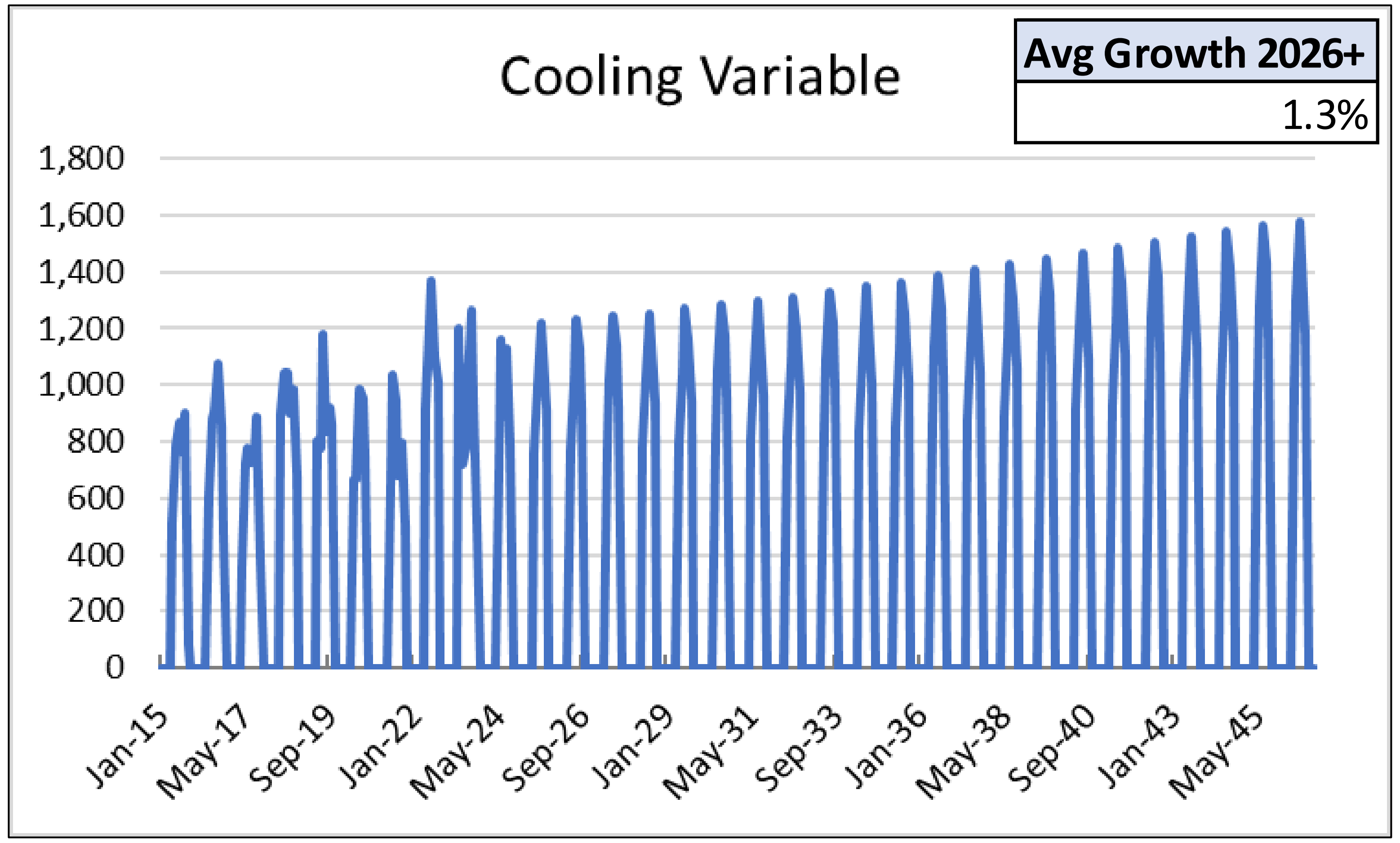


Peak model drivers





- → Heating, cooling, and base-use energy requirements derived from tariff sales forecast models
- → Base-use energy allocated to end-use coincident peak loads. Highest load in winter – lighting load



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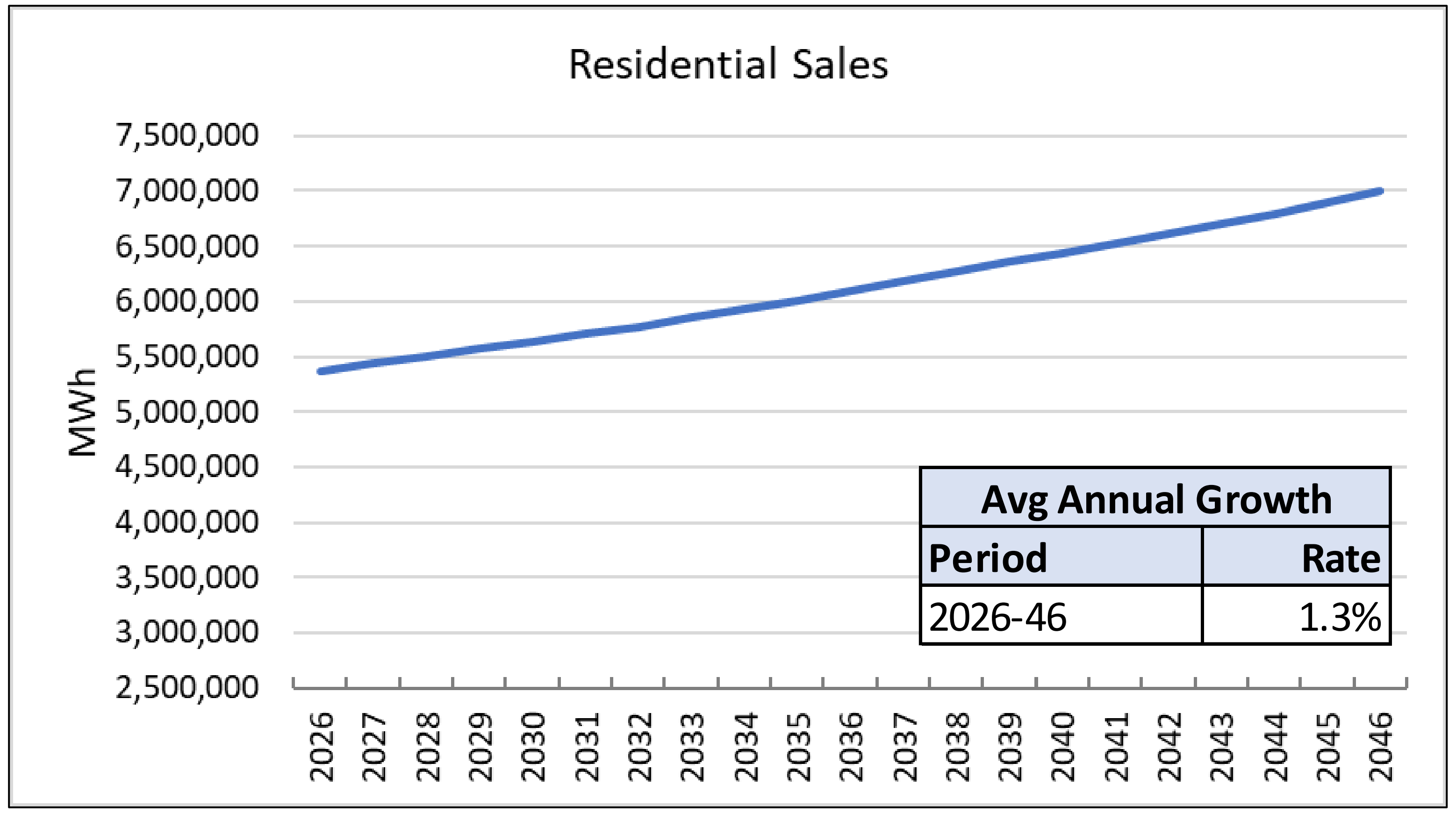
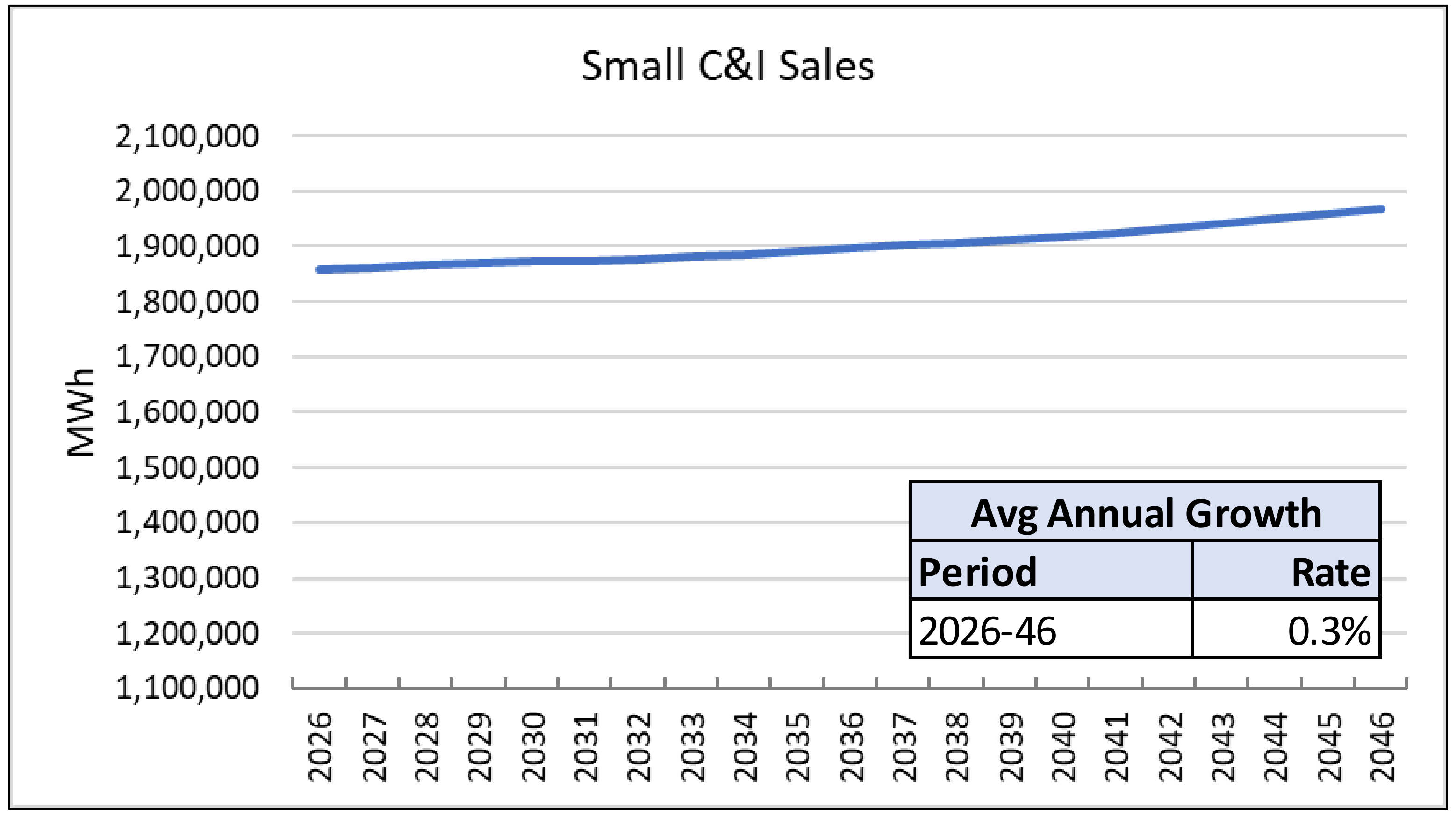
Forecast Results

Class sales forecast



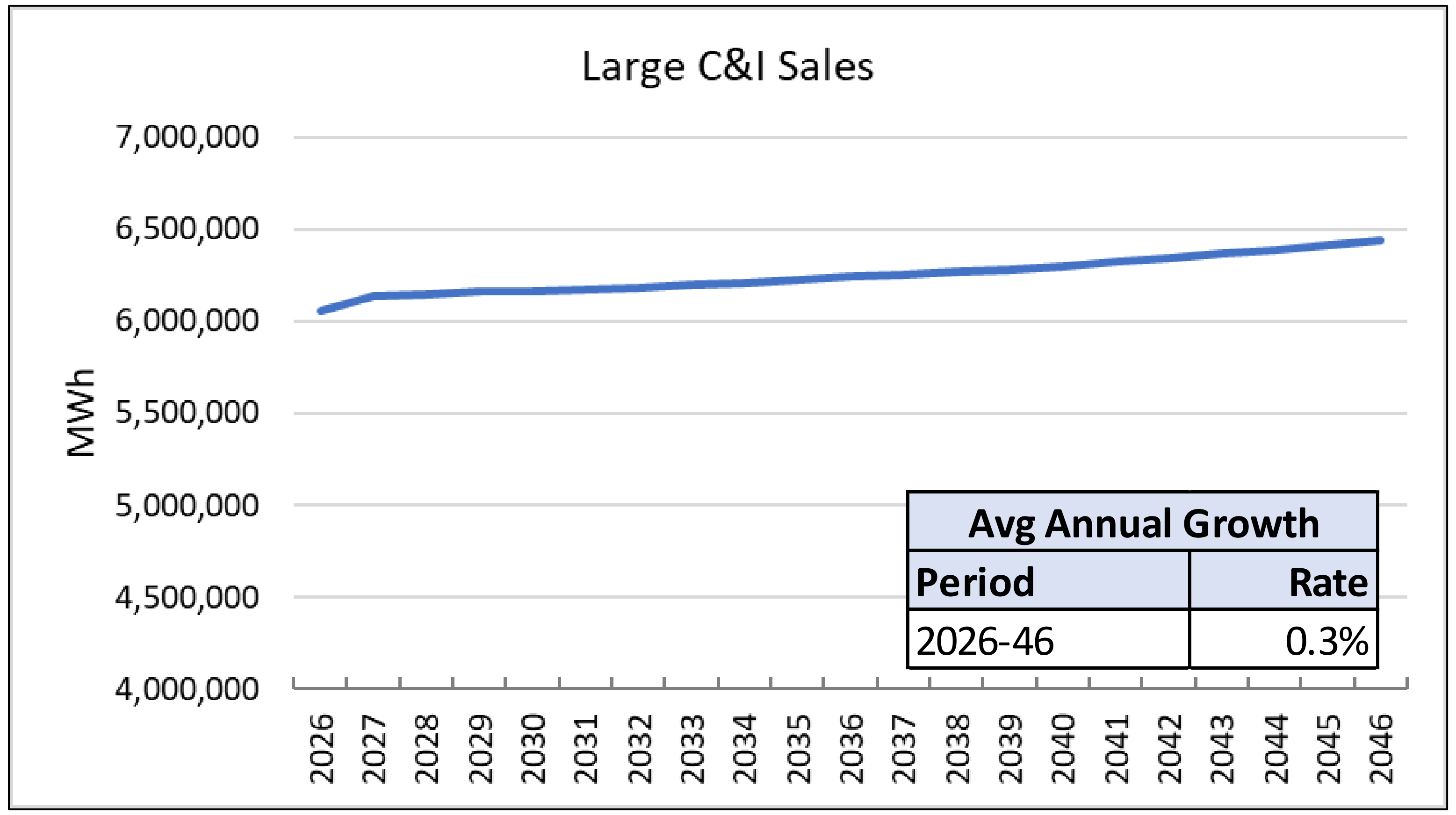


Excludes:

→ Future EE savings

→ Electric vehicle charging loads

→ Future solar adoption



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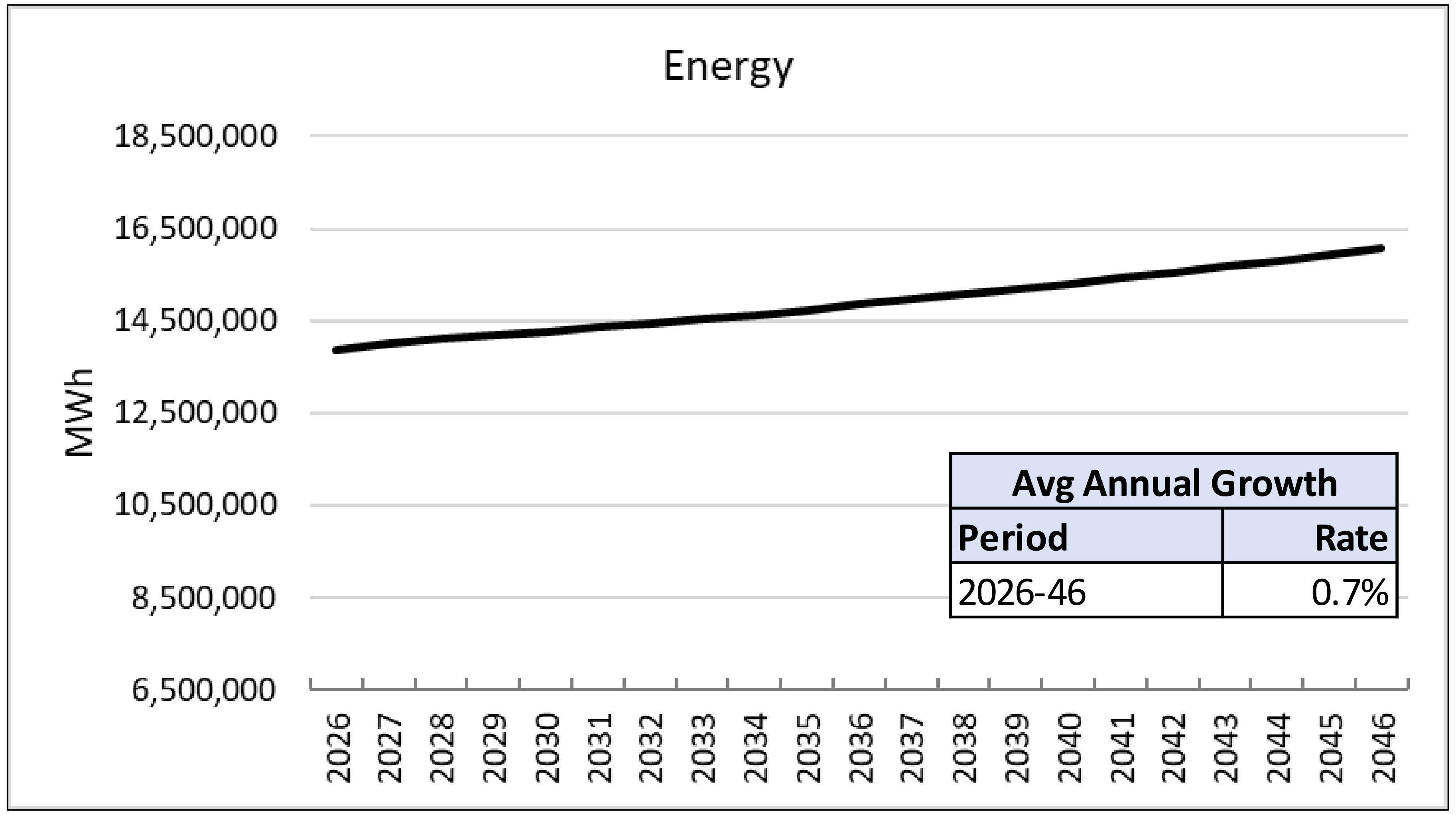
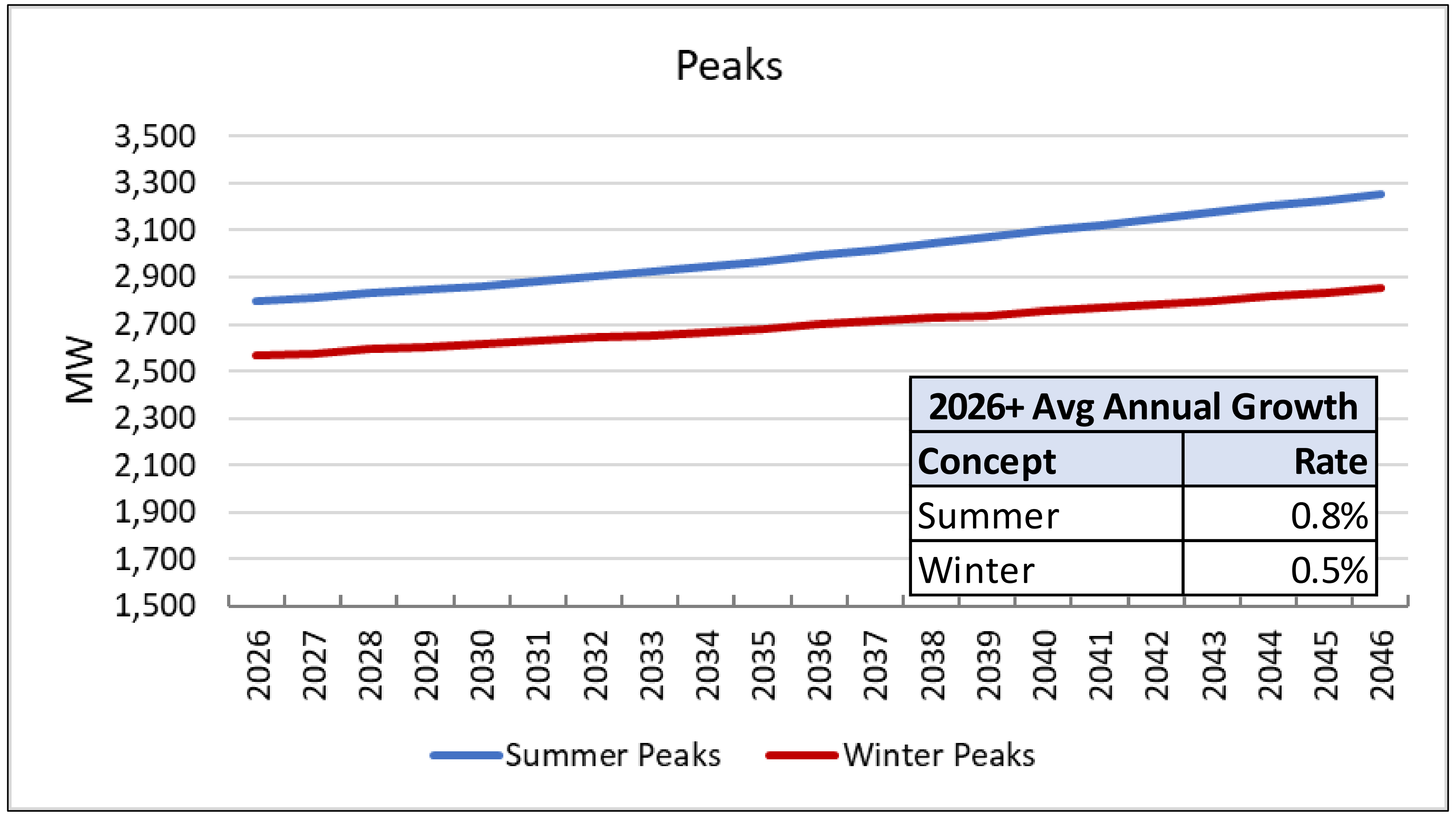
Energy and peak forecast



Avg Annual Growth	
Period	**Rate**
2026-46	0.7%



2026+ Avg Annual Growth	
Concept	**Rate**
Summer	0.8%
Winter	0.5%

→ Forecast excludes future EE, electric vehicles, and solar impact

Electric vehicle (EV) / solar PV forecasts

Woody Zhu, Assistant Professor, Carnegie Mellon University

Introduction

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Assistant Professor

Wenbin Zhou

PhD Student

AES

Erik Miller

Director, Resource Planning

Rob Whitworth

Sr Manger, T&D Planning

Ryan Yang

Load Forecast Analyst

Victoria Cooper

EV Program Manager

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Distributed energy resource

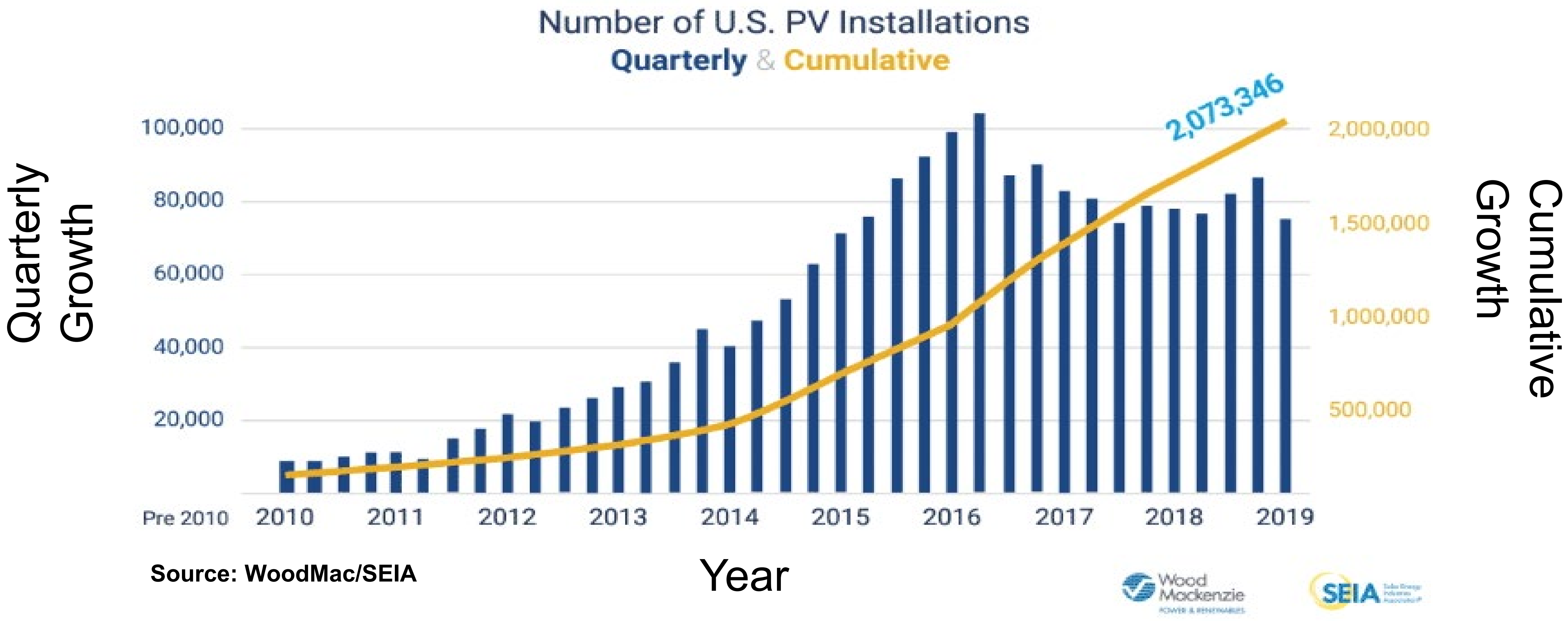
Distributed energy resources (DERs) are small-scale energy generation and storage technologies that are connected to the electricity distribution system.

Electric Vehicles (EV)

Customer Solar

Objective

Number of solar installations in the United States



Source: WoodMac/SEIA

→ Provide a long-term substation-level and territory-level forecast for the growth of EV and customer solar on AES Indiana's system.

→ Provide base, high, and low forecasts for inclusion in AES Indiana IRP Scenario Analysis.

→ Reveal insights that inform strategic decision-making.

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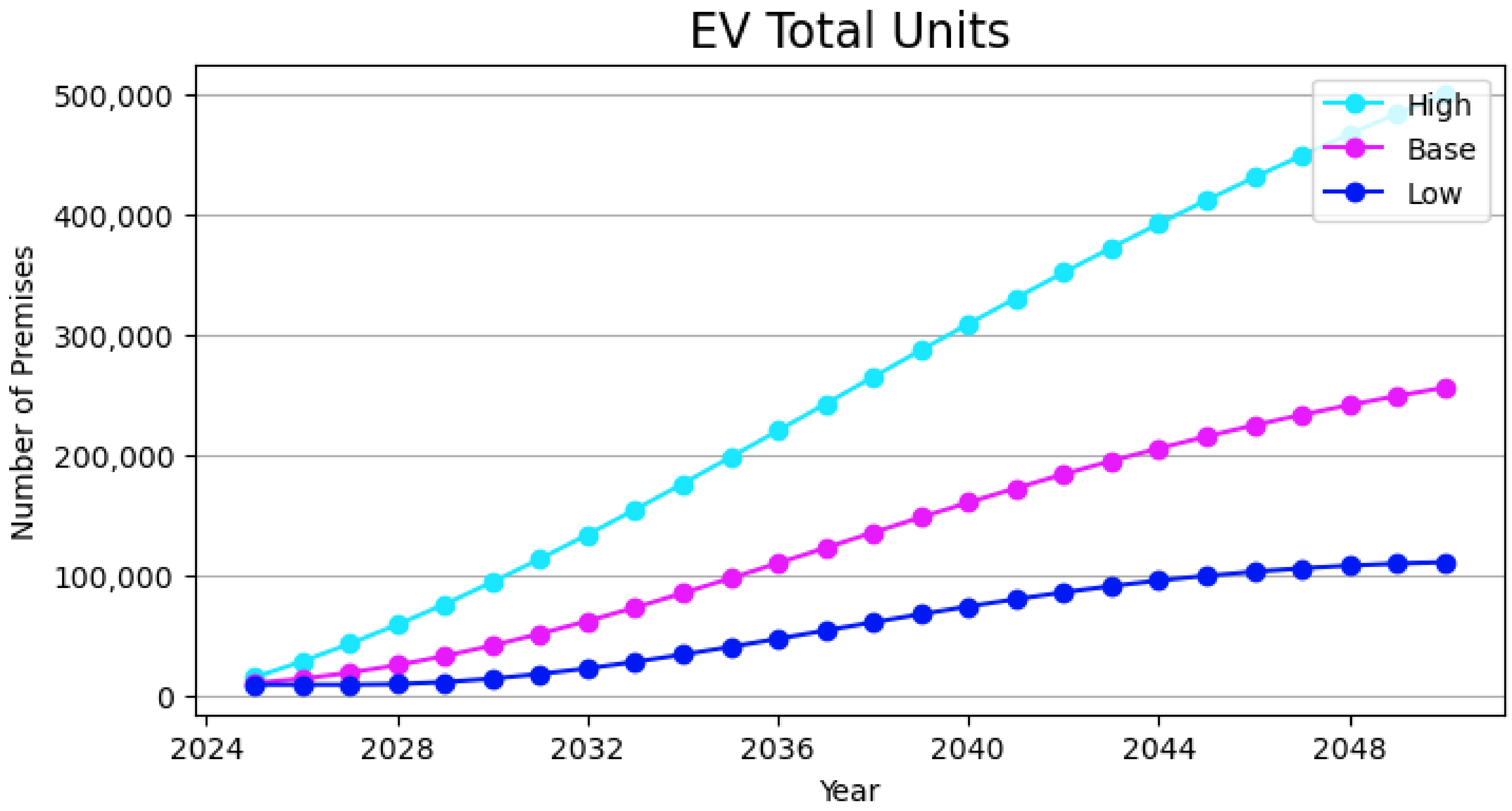
Result: EV unit prediction

110k~500k



A steadily accelerating market and increasing uncertainty over the coming decades, underscoring the need for:

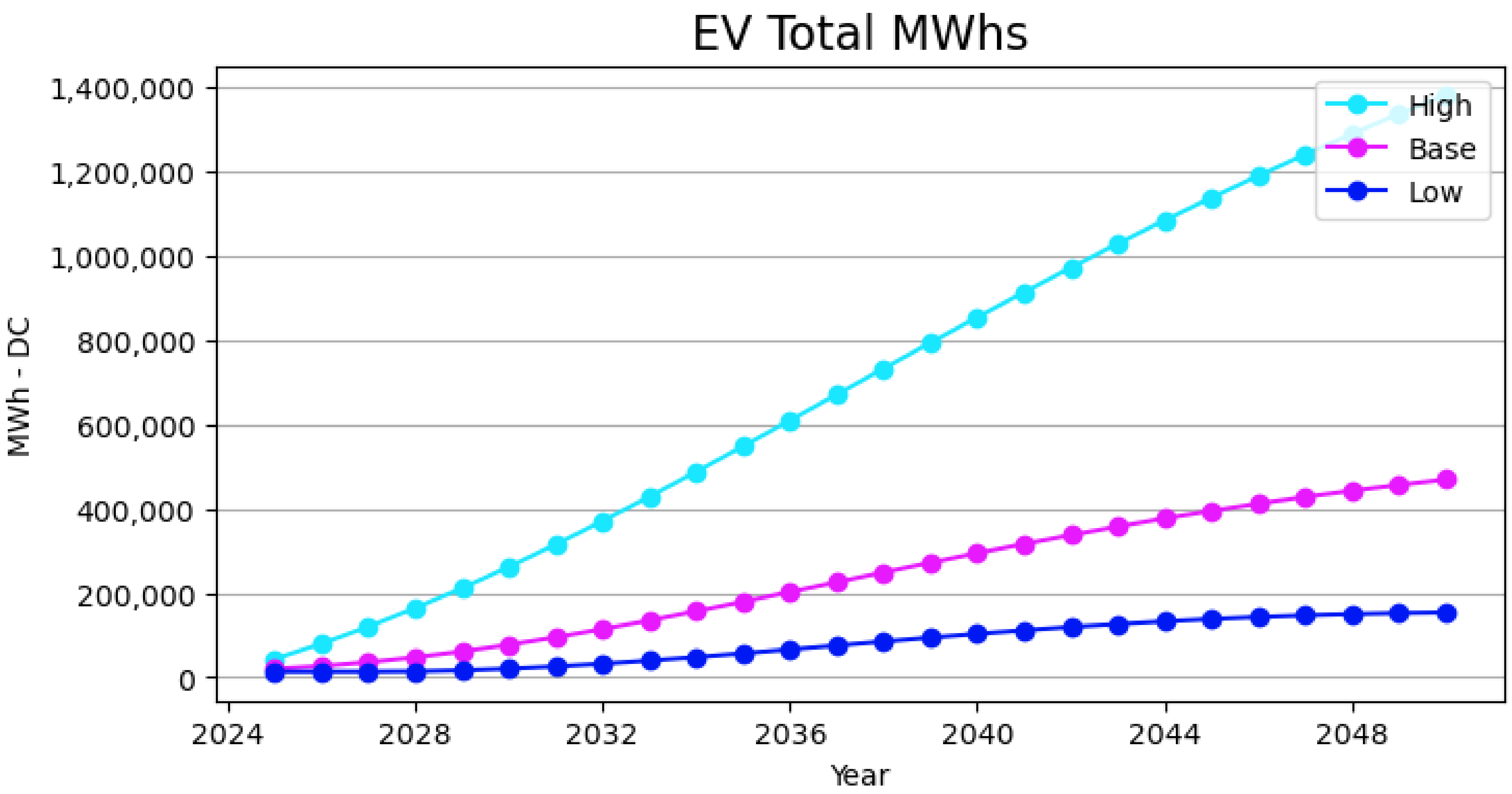
→ proactive infrastructure investments,

→ resource planning, and

→ strategic readiness to capitalize on rising demand.

Result: EV energy (MWh) prediction

0.2M~1.4M



A steadily accelerating market and increasing uncertainty over the coming decades, underscoring the need for:

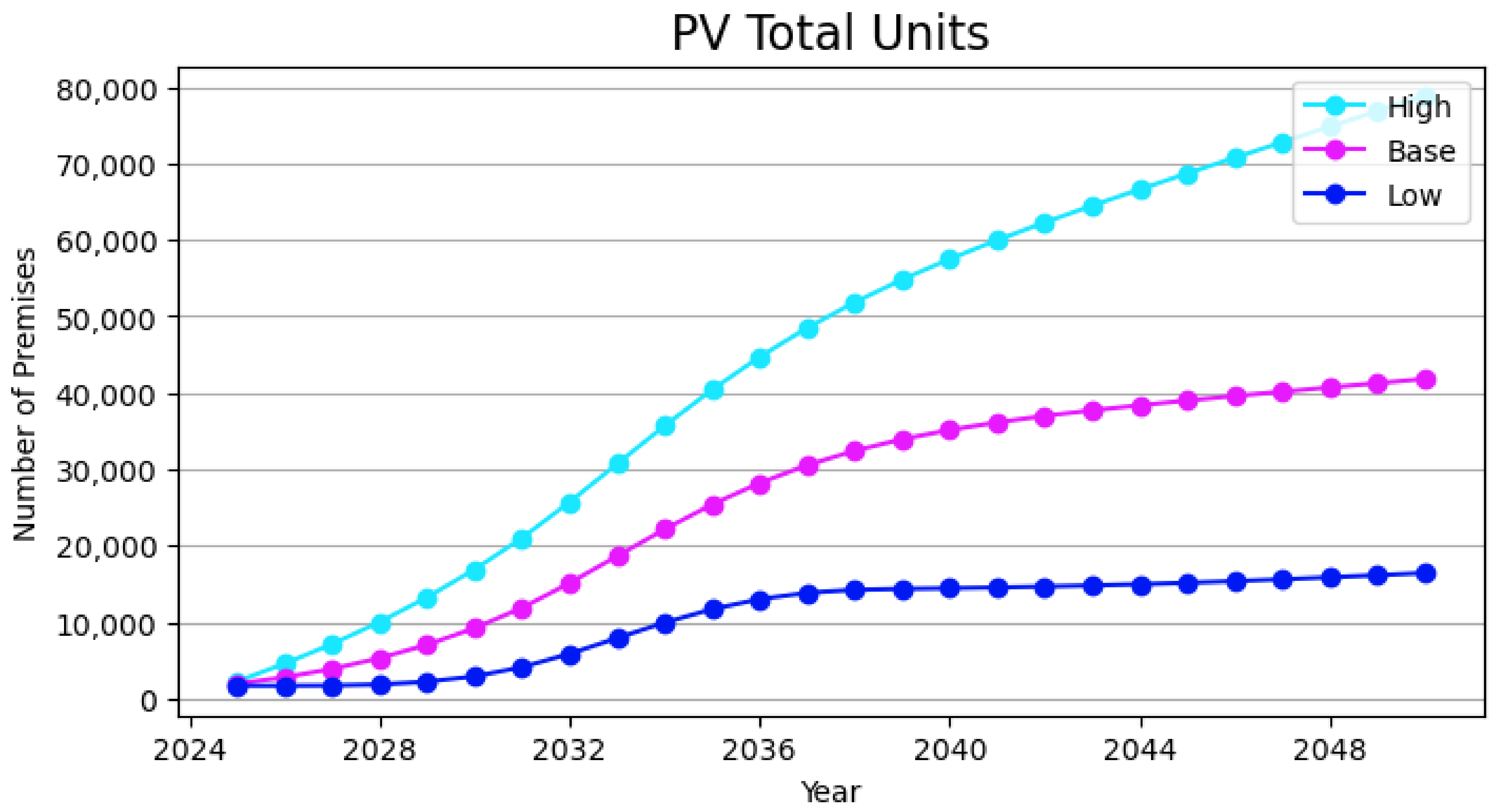
→ proactive infrastructure investments,

→ resource planning, and

→ strategic readiness to capitalize on rising demand.

Result: Customer solar unit prediction

18k~80k



A steadily accelerating market and increasing uncertainty over the coming decades, underscoring the need for:

→ proactive infrastructure investments,

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→ strategic readiness to capitalize on rising demand.

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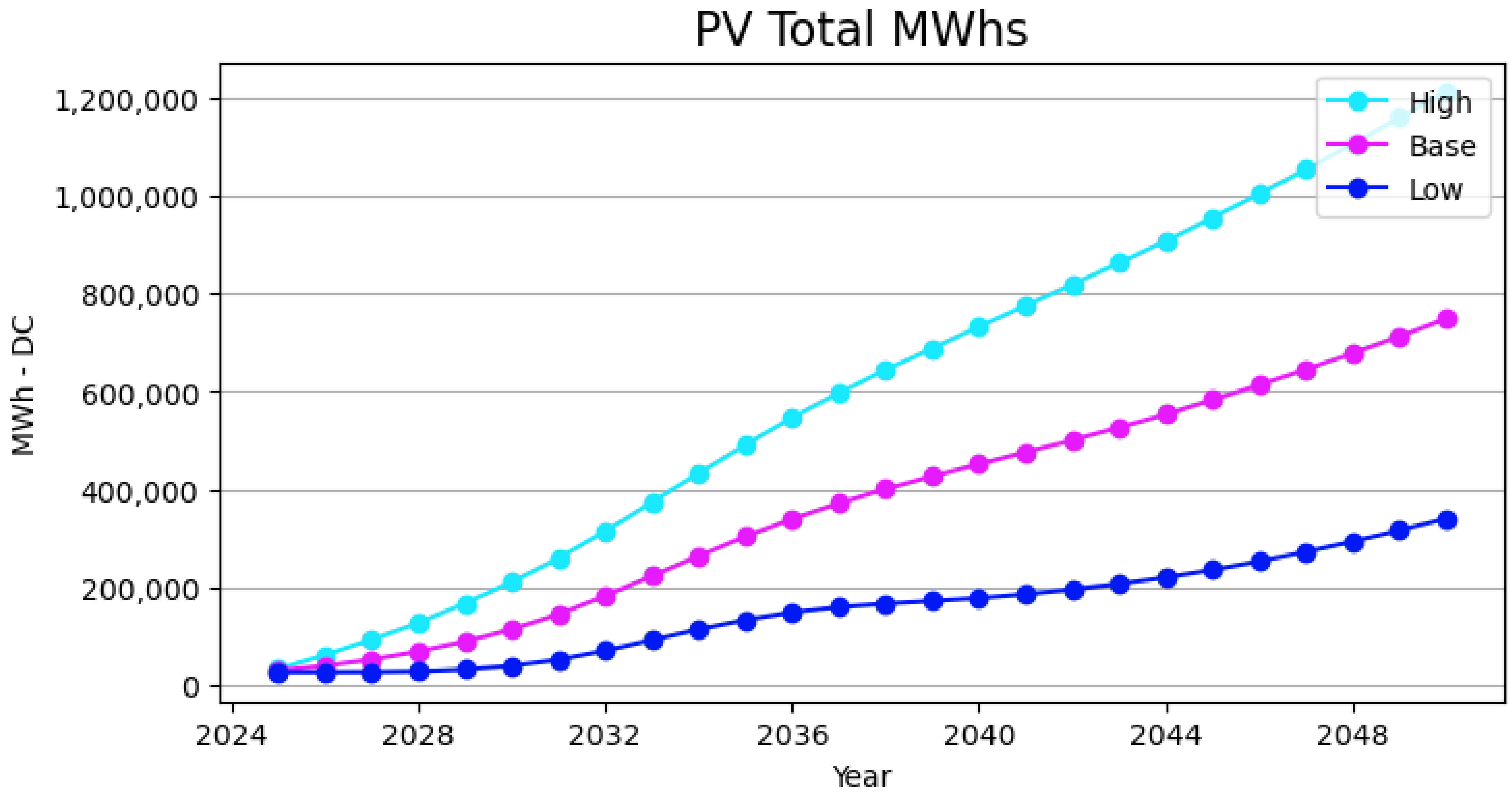
Result: Customer solar energy (MWh) prediction

0.3M~1.2M



A steadily accelerating market and increasing uncertainty over the coming decades, underscoring the need for:

→ proactive infrastructure investments,

→ resource planning, and

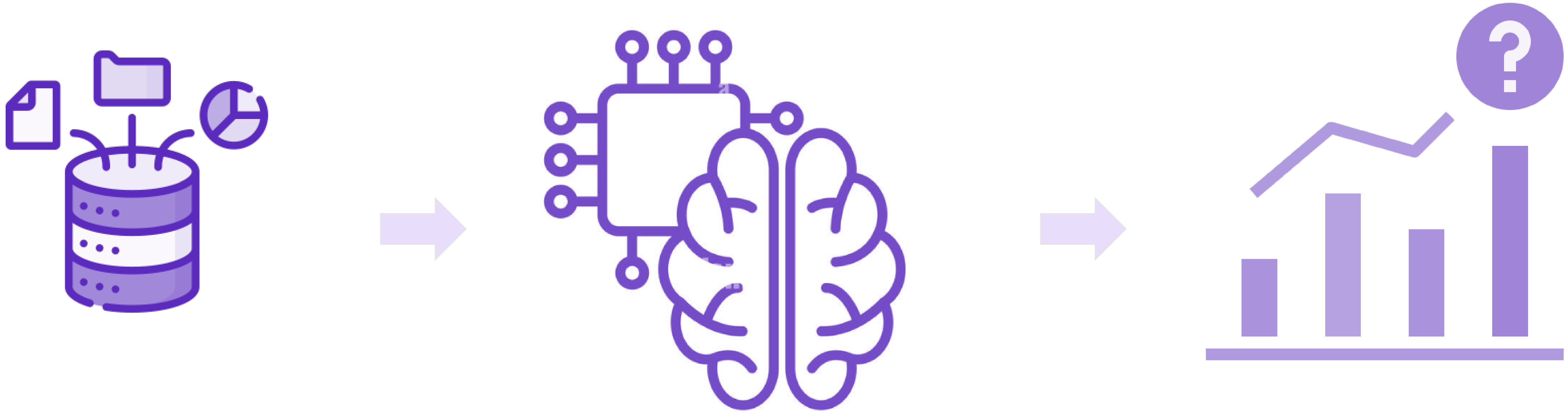
→ strategic readiness to capitalize on rising demand.

Key takeaways

- →A **rapid initial growth** phase for EV/solar adoption, which gradually slows, with **a plateau projected around 2036**.

- →At the substation level, our analysis identifies **significant spatial disparity** in growth magnitude and uncertainty.
  - →This pattern suggests that high-adoption substations are also areas of high forecast uncertainty.

Methodology



Real-world data

Machine learning model

Forecast & insight

Data overview

→**PV data** (Customer solar records from AES)

→**EV data** (Vehicle registration records from Indiana BMV)

→Power grid data (from AES)

- →Outage records
- →Load records

→Census data (from US Census Bureau)

- →Demographic survey collected by ACS

Electric vehicle energy (MWh) forecast

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

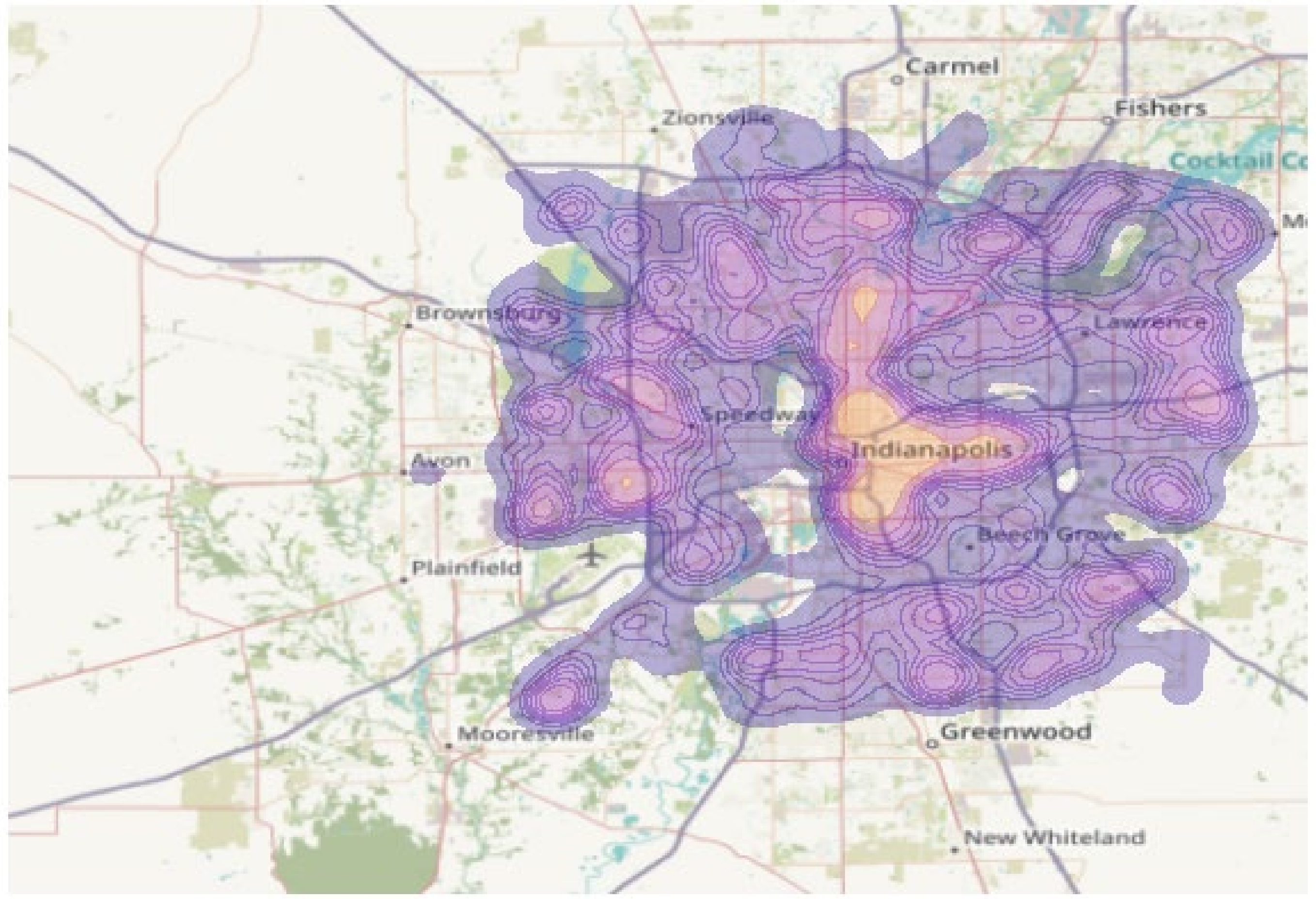
Assumption Chart

Input	Base	High	Low	Source
Average kWh/mile	0.345			Department of Energy & Energy Information Administration
Miles/year/vehicle	5,300	8,000	4,000	Car & Driver

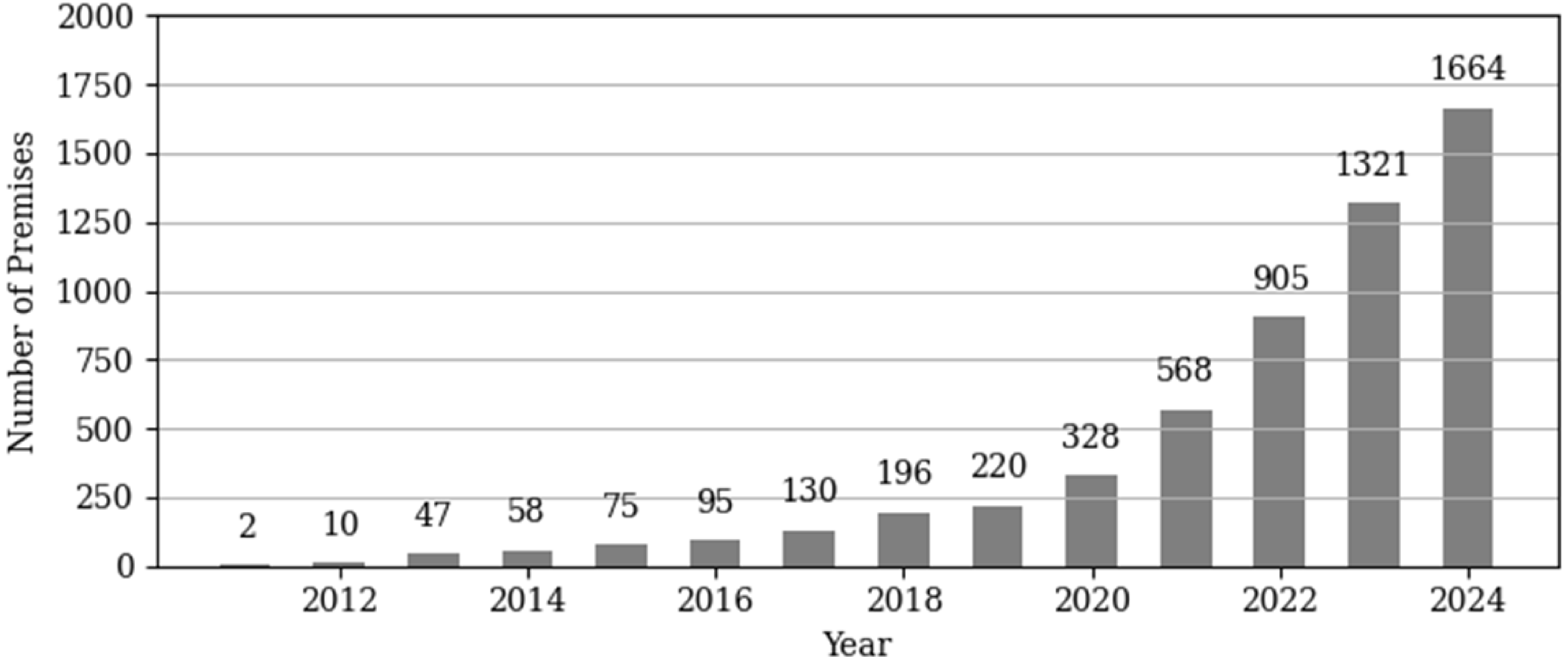
Follow the same rule from IRP 2022

Data overview: PV data

Heatmap of Historical PV Installations before 2025



Cumulative Historical PV Installations



→Rapid growth

→High PV demand in downtown Indianapolis

→Strong spatial heterogeneity

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Data overview: EV data

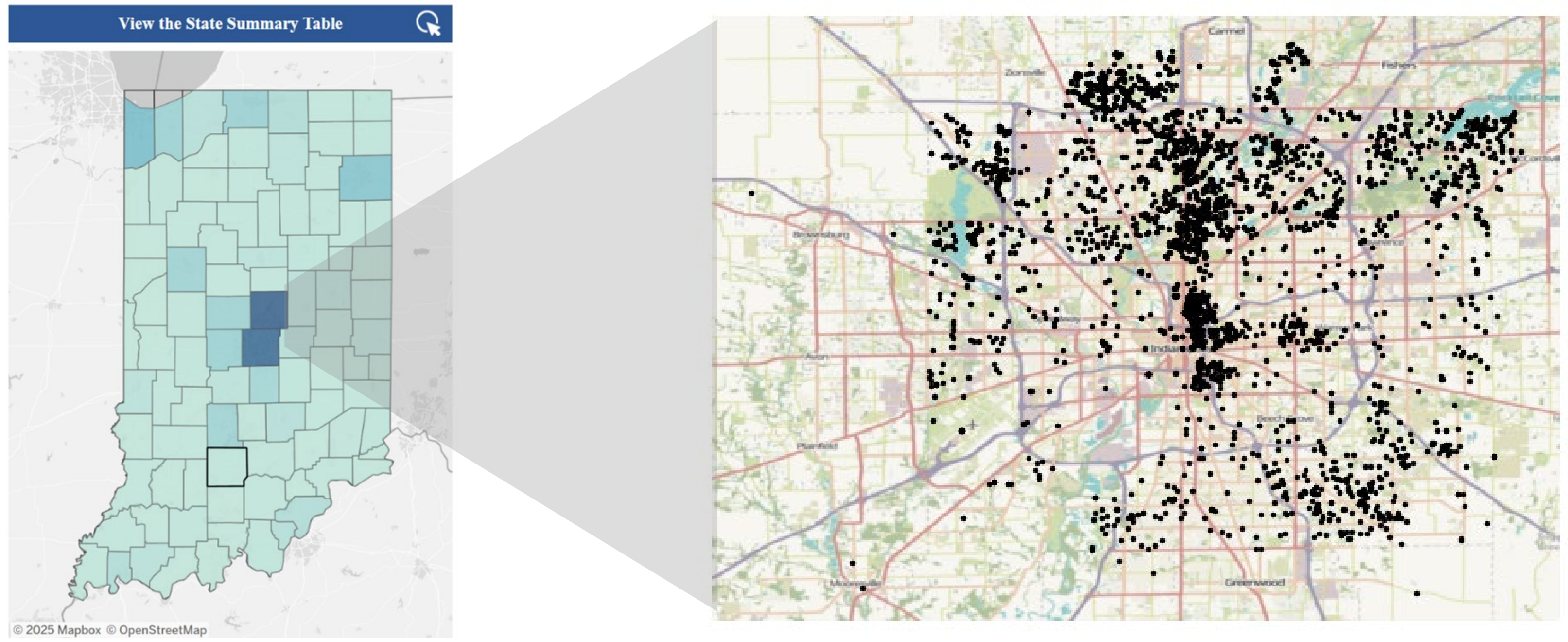
→**Concentration in AES Service Region**

→**Fast-growing trend** compared to other vehicle types (e.g. gas)

→**Strong spatial heterogeneity**

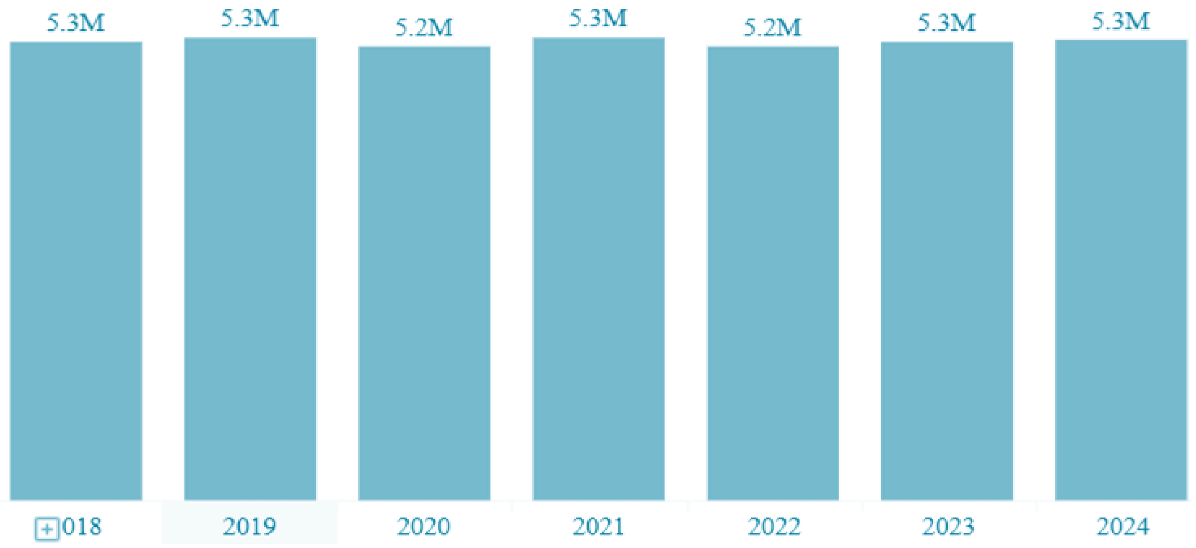
EV in Indiana

AESIndiana service region

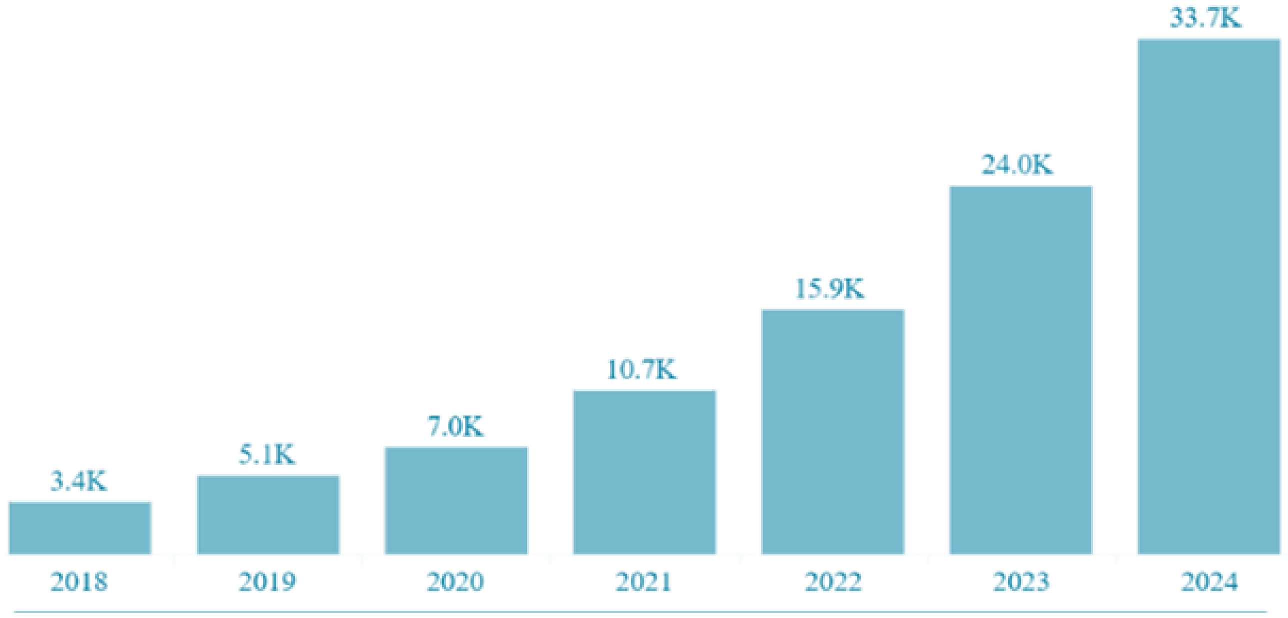


Gas Vehicles

Registration per year in Indiana



EV Registration per year in Indiana



Indiana Office of Energy Development

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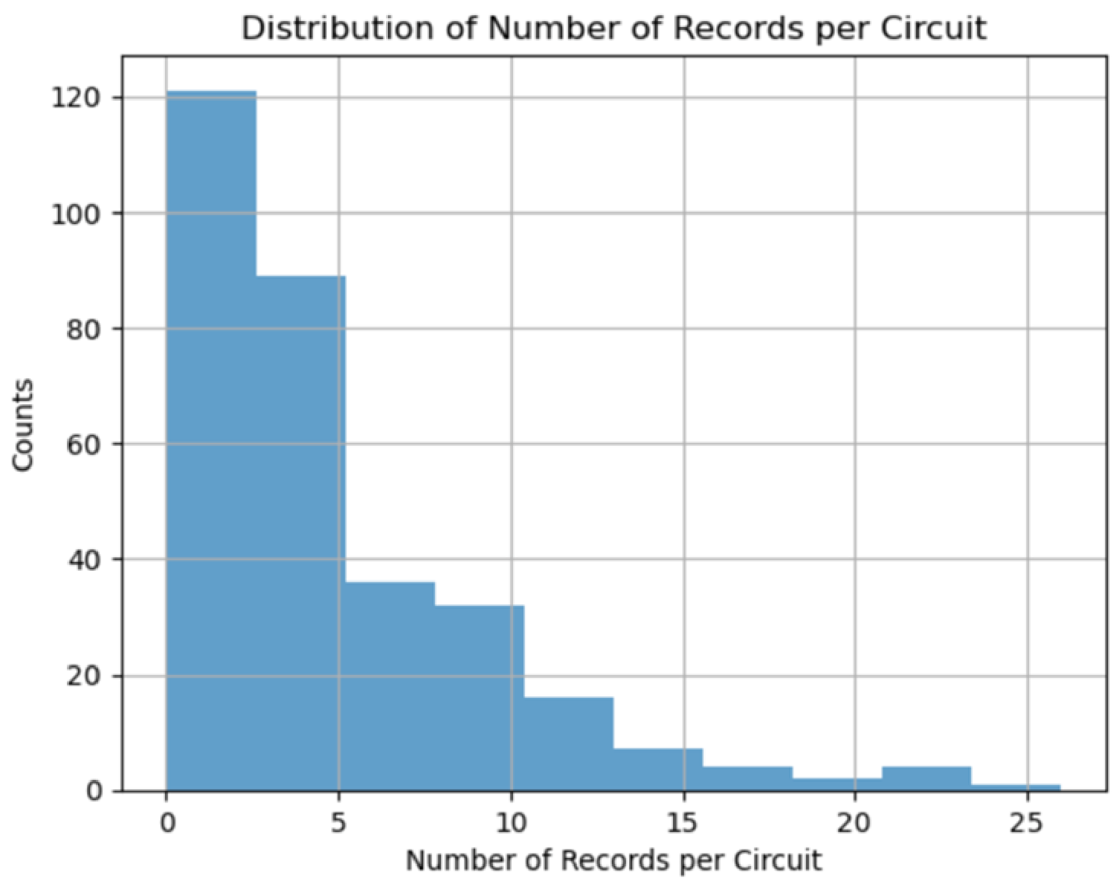
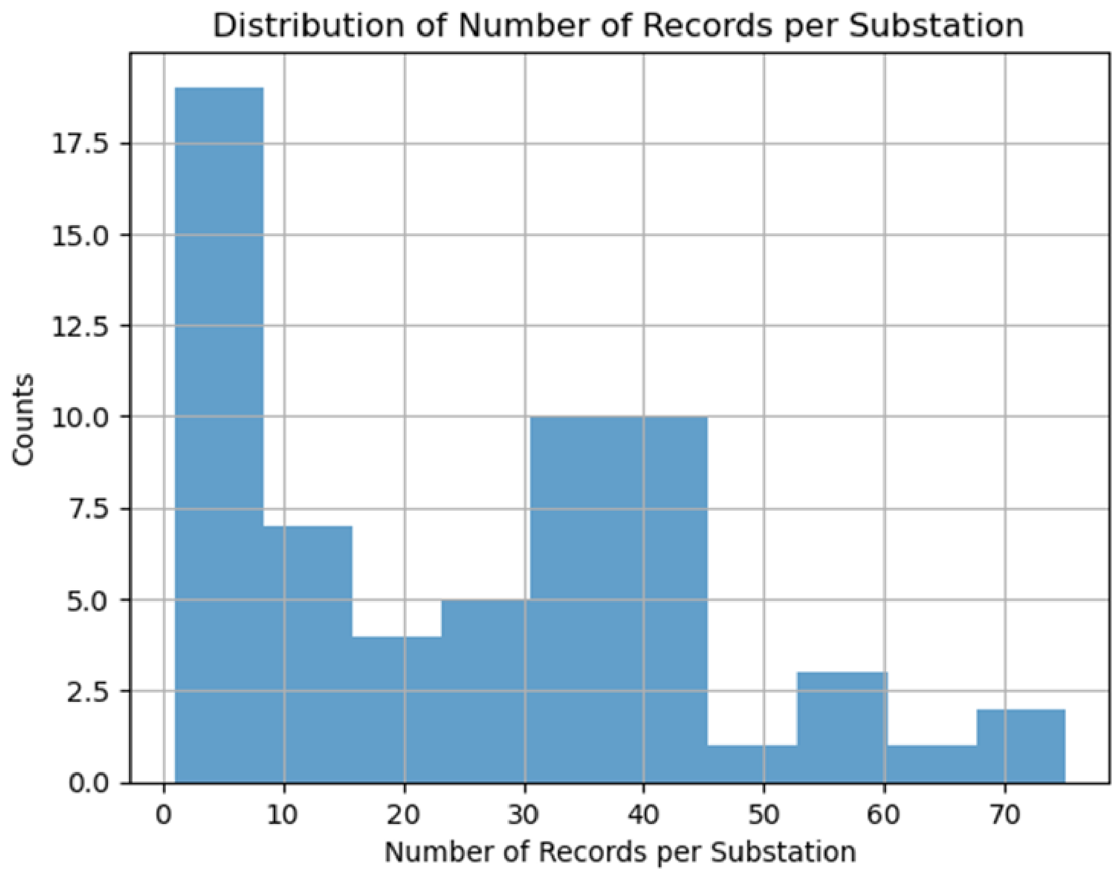
Distribution system analysis



~5 installations per circuit



~24 installations per substation

→**Data sparsity** at substation and circuit level.

→**Need action** to meet growing demand.

- →e.g. substation average ~24 installations (2025) to ~786 installations (2050 prediction)

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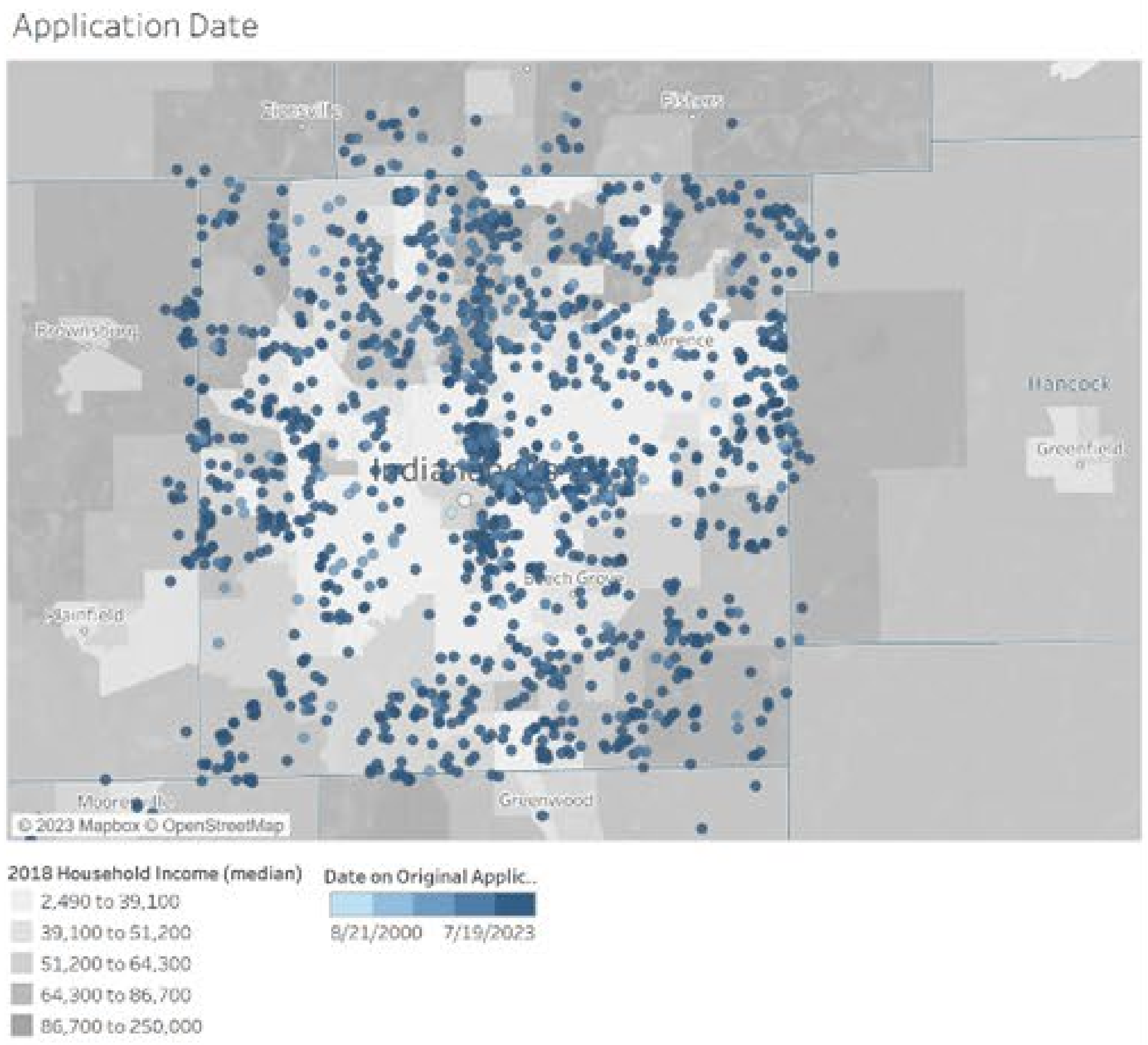
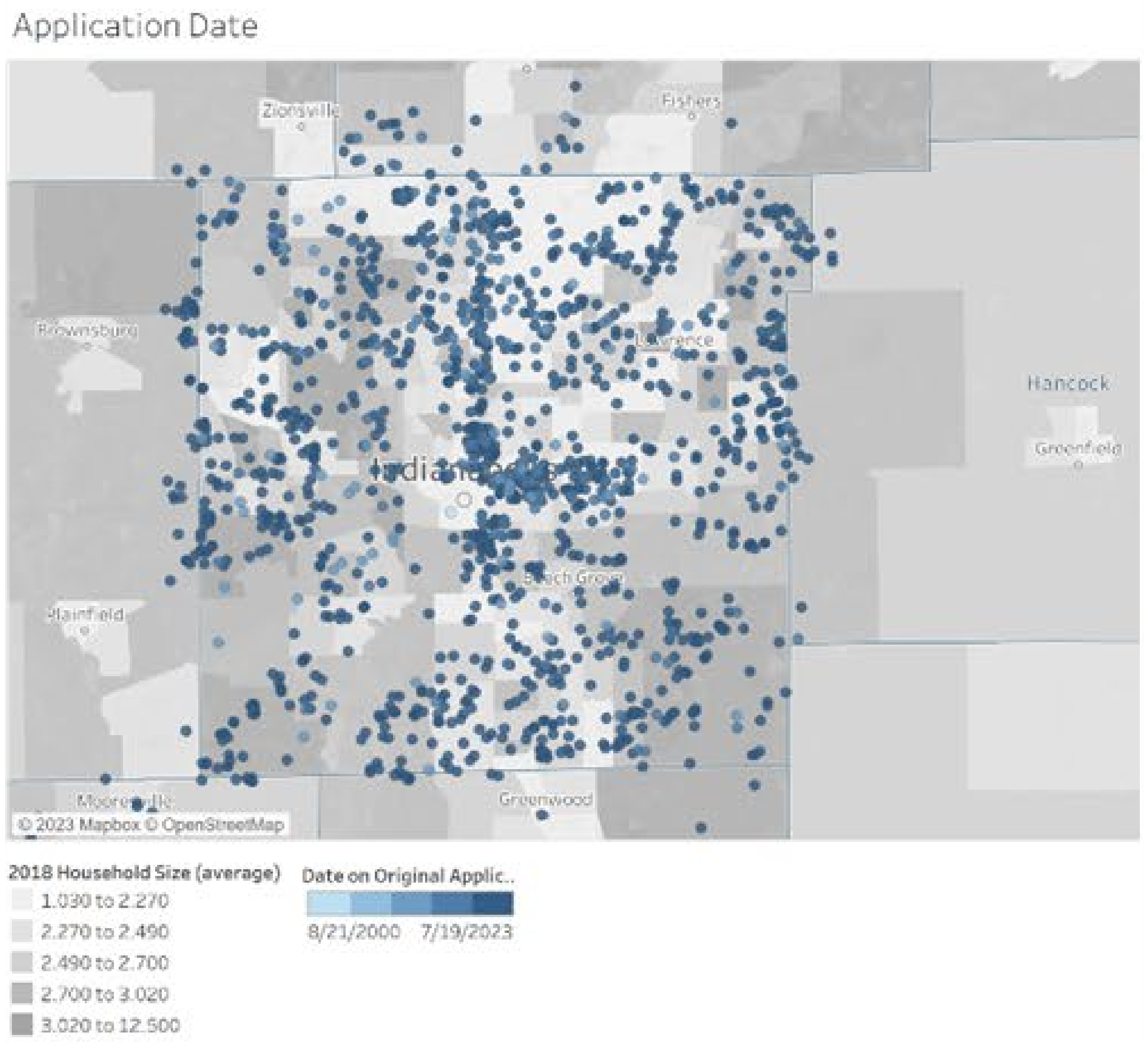
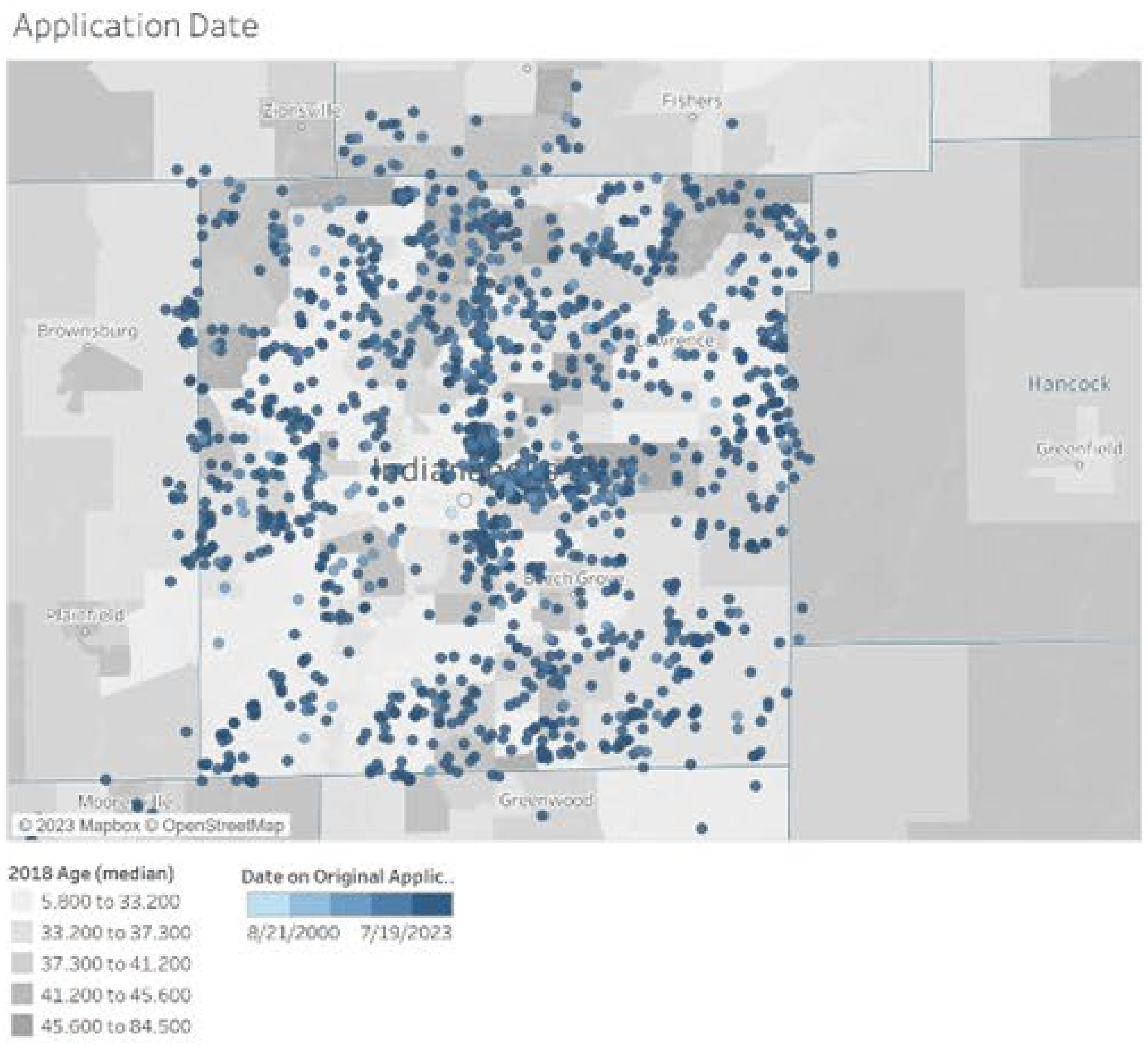
Correlation analysis



Household income



Household size



Median age

→EV / PV growth **depends on other covariates**

→Need to **include these covariates into the prediction**

Takeaways from data analysis

→DER Data shows considerable **sparsity** both temporally and spatially.

→Individual unit records are highly **random** and **unpredictable**.

→The growth of DER may **depend on some key exogenous factors**.

Method

→Machine Learning Model for EV/PV Adoption

  →Base Forecast

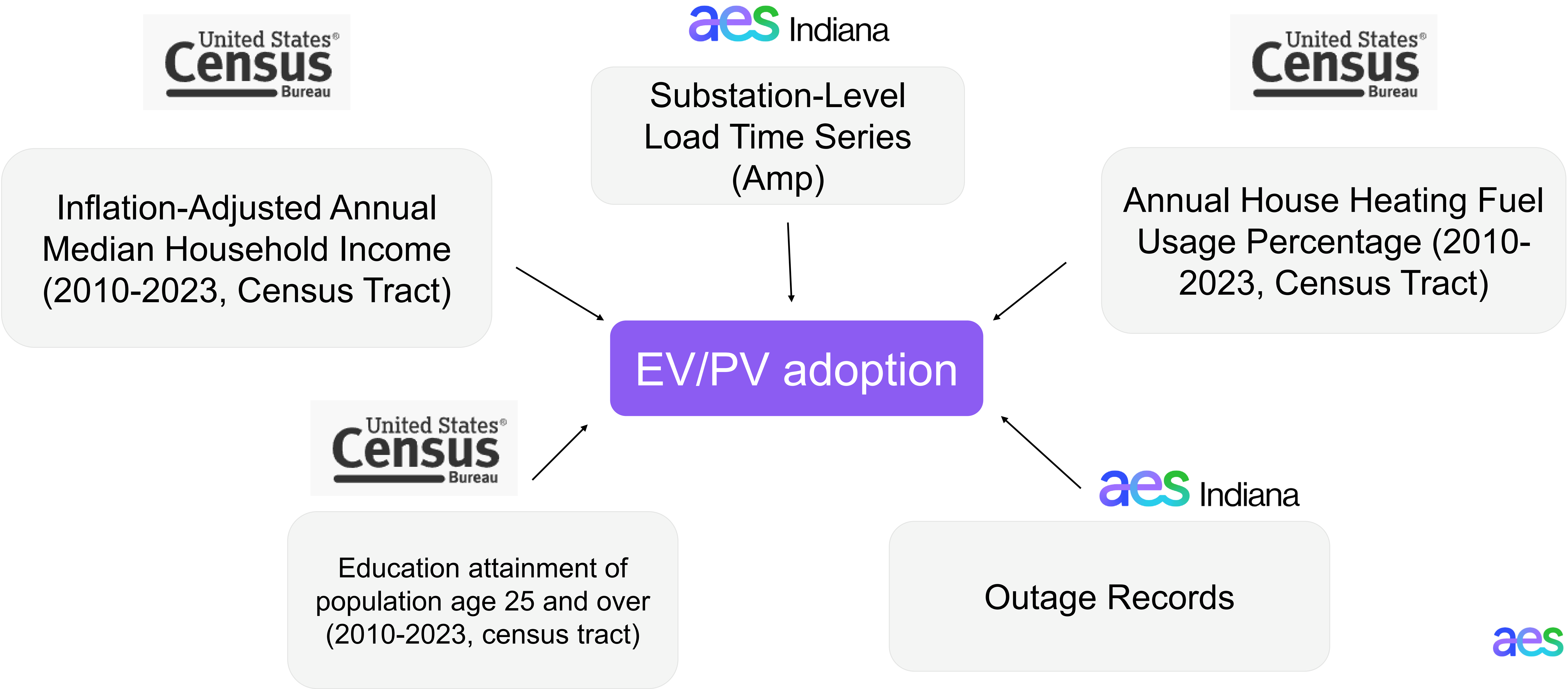
→Statistical Framework for Uncertainty Quantification

  →High and Low Forecast

→Model Evaluation

EV/PV prediction model

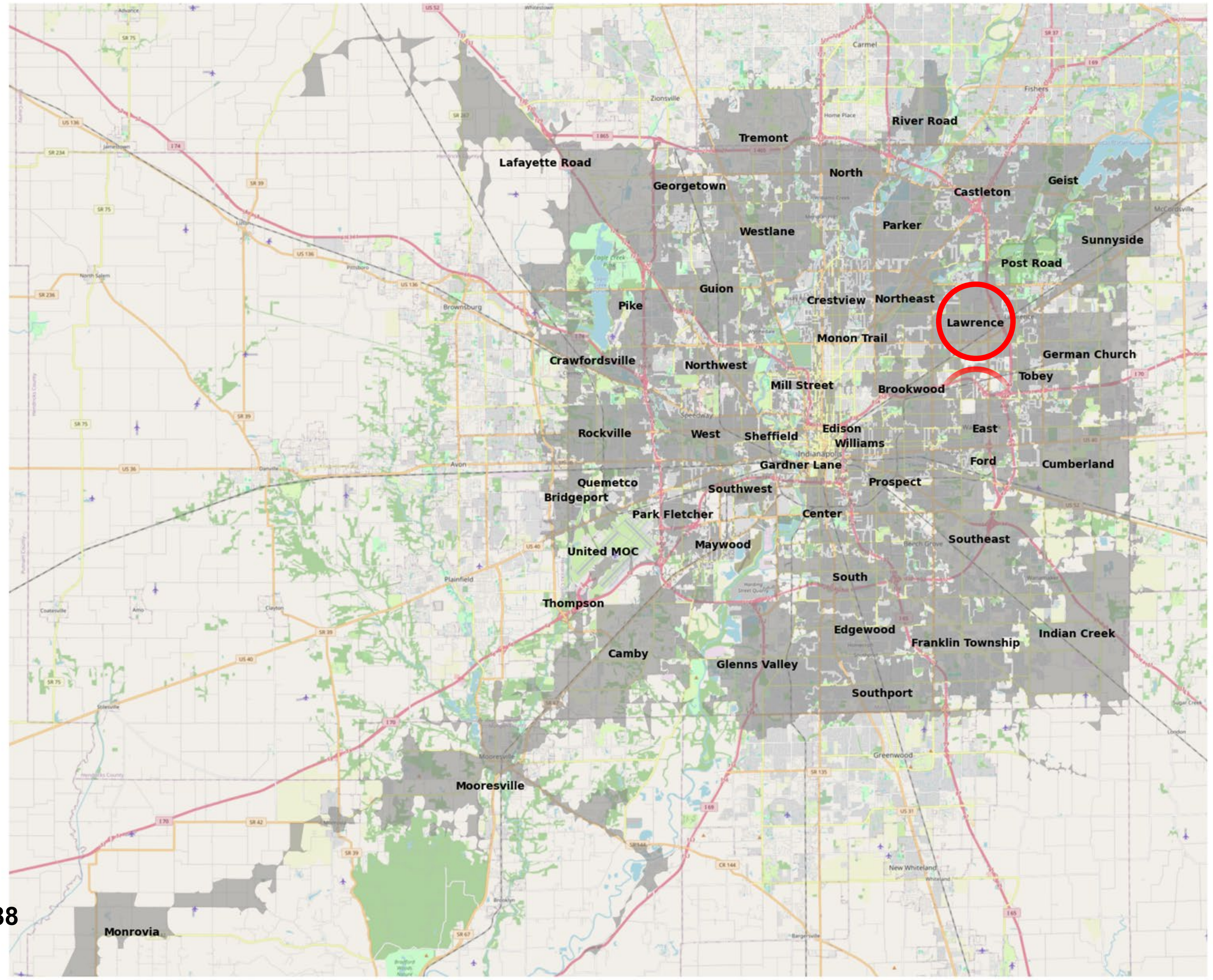
Adoption in the next month in a region = **Exogenous Influence** + Endogenous Effect

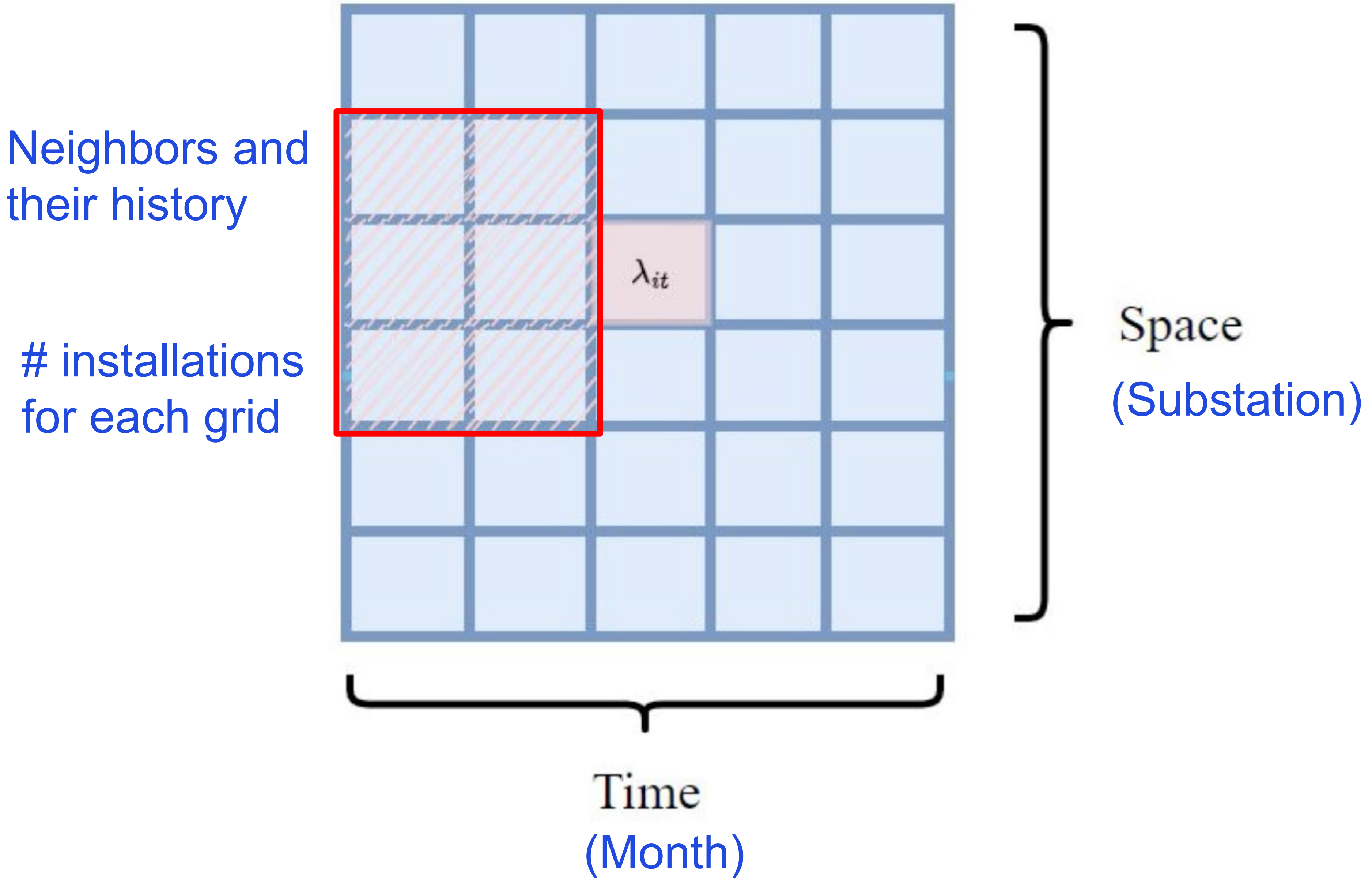


EV/PV Prediction Model

Adoption in the next month in a region = Exogenous Influence + **Endogenous Effect**

"The adoption in a substation may depend on the adoption level of its history and neighbors."



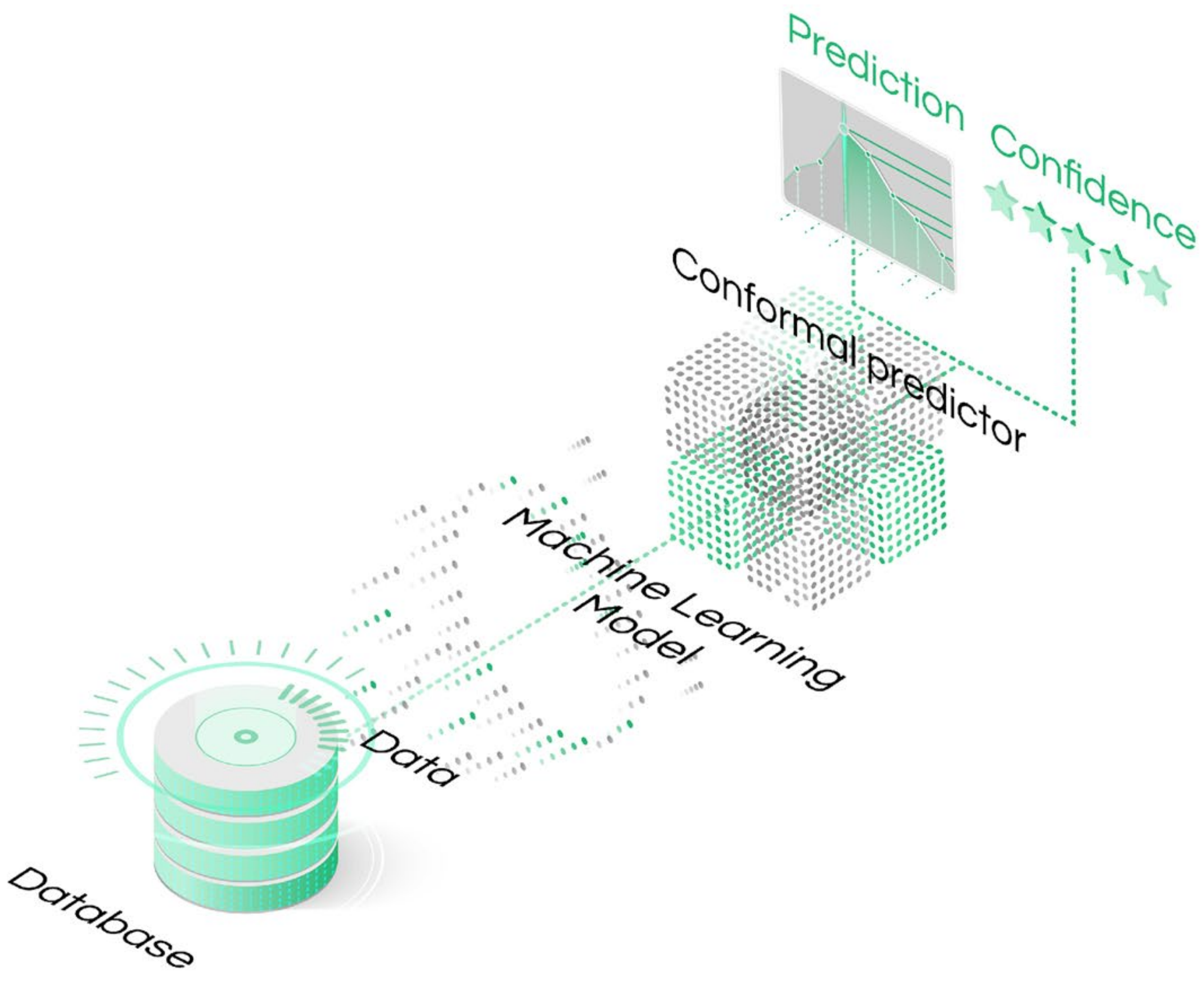


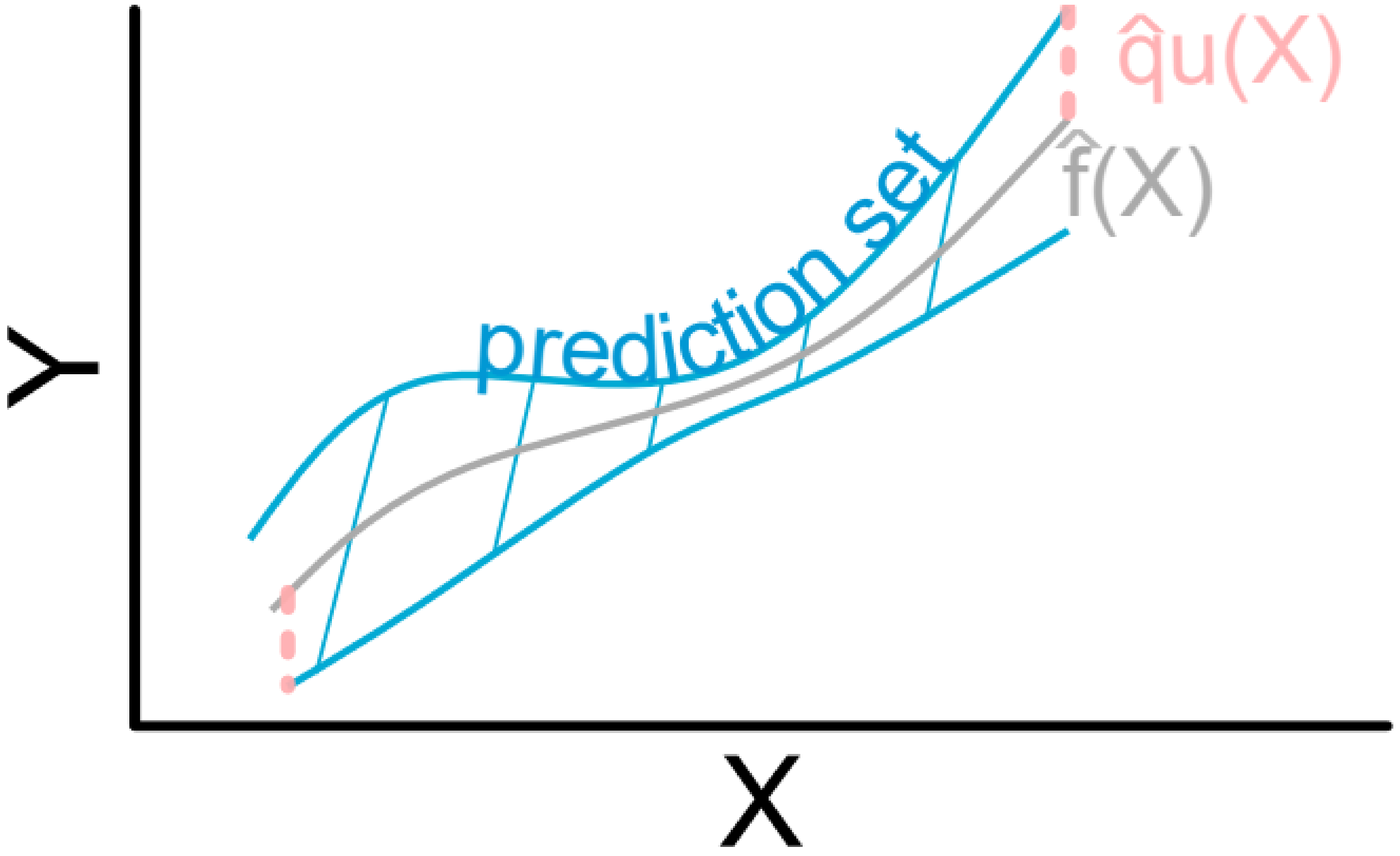
Uncertainty quantification

Conformal Prediction

A model-agnostic uncertainty quantification framework

Construct the high and low base prediction





Hyper-parameters selection (EV)

Supporting evidence to our key assumptions on the hyperparameters:

→ **Confidence level:** Confidence with the low and high predictions

→ Quality and quantity of data + model evaluation

→ **Our choice: 70%**

→ **Tipping point:** The timing when fastest growth rate hits

→ Expert opinions: US tipping point arrives 2021~2031.

- Camus Energy: Indianapolis region arrives at 2029

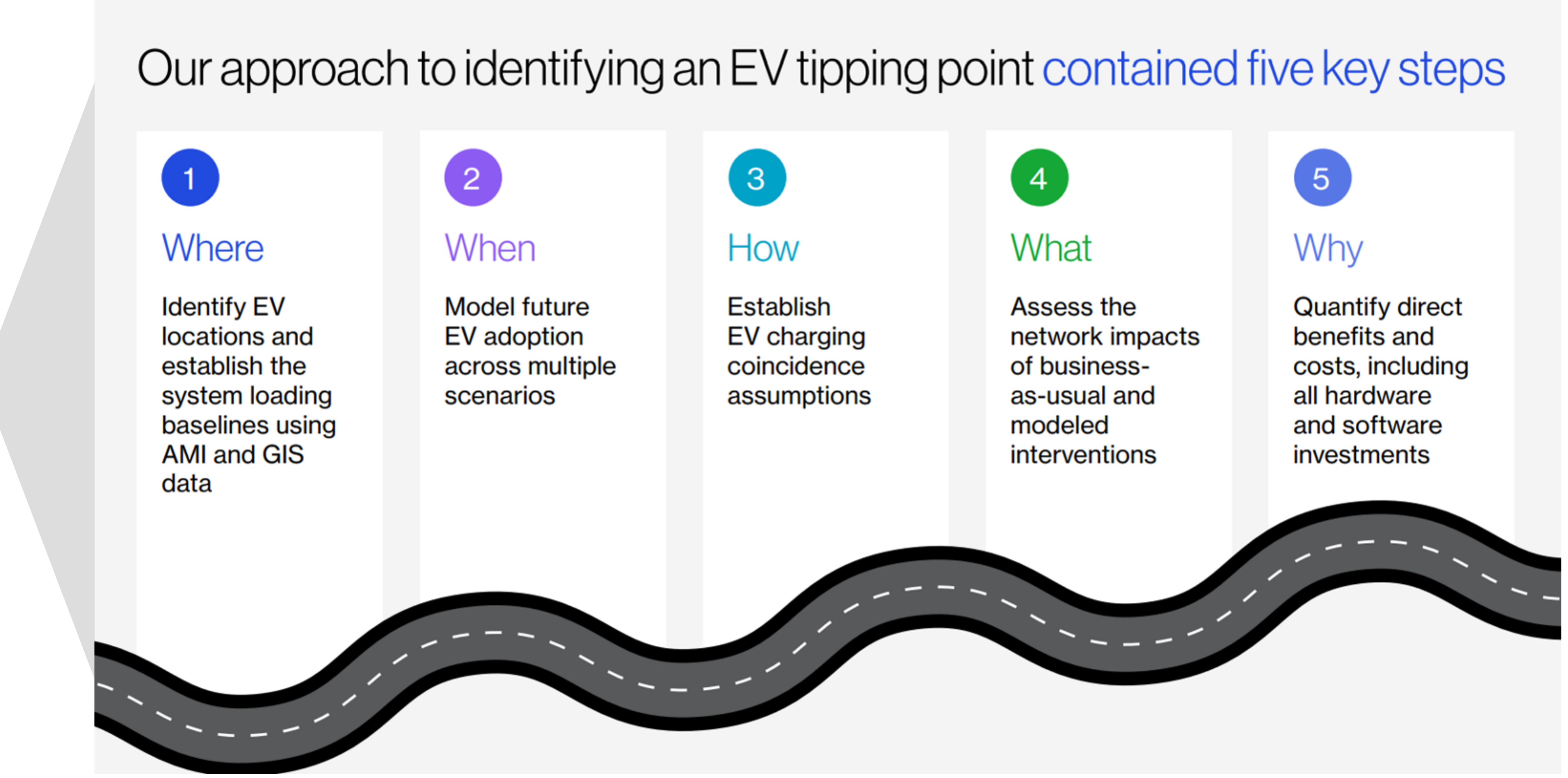
→ **Our choice: 2029**

→ **Penetration rate:** Saturated market size theoretical limit

→ Multiple public surveys: >50% of American people will consider purchasing EV

- e.g. 54%, 57%, 38+40=78%

→ **Our choice: 56%**



Hyper-parameters selection (PV)

Supporting evidence to our key assumptions on the hyperparameters

Confidence level: Confidence with the low and high predictions

→Quality and quantity of data + model evaluation

→**Our choice:** 90% (Res) and 10% (Com)

Tipping point: The timing when fastest growth rate hits

→*SEIA:* solar panel growth trend continue rising until 2029

→Indiana ranks high (12th) in solar generation.

→Policy incentives (e.g. ITC CEIC) effective until 2032

→**Our choice:** 2032

Penetration rate: i.e. saturated market size theoretical limit

→Current highest state: California = 8%

→**Our choice:** 7% (Res) and 4% (Com)

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14	**Los Angeles**	CA	Pacific	166.7	649.9	1
15	**Sacramento**	CA	Pacific	159.8	83.9	14
16	**Indianapolis**	IN	North Central	142.1	126.1	12
17	**Newark**	NJ	Northeast	112.0	34.9	27
18	**Hartford**	CT	Northeast	102.1	12.4	41
19	**Charleston***	SC	South Atlantic	101.5	15.2	38

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User portal

Dashboard demo link:

EV:
https://wbzhou2001.github.io/EVPV-Dashboard/ev_dashboard.html

PV:
https://wbzhou2001.github.io/EVPV-Dashboard/pv_dashboard.html

References and more detail of hyperparameter selection are included.

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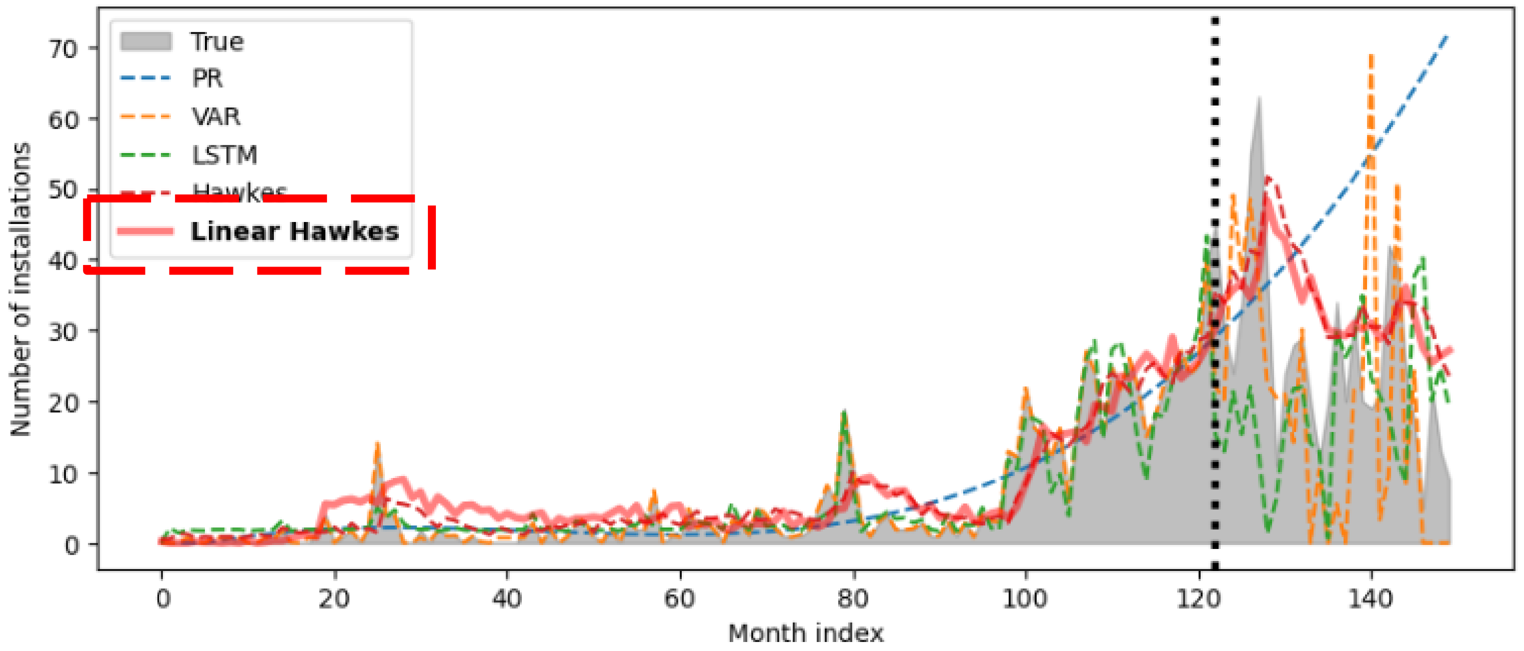
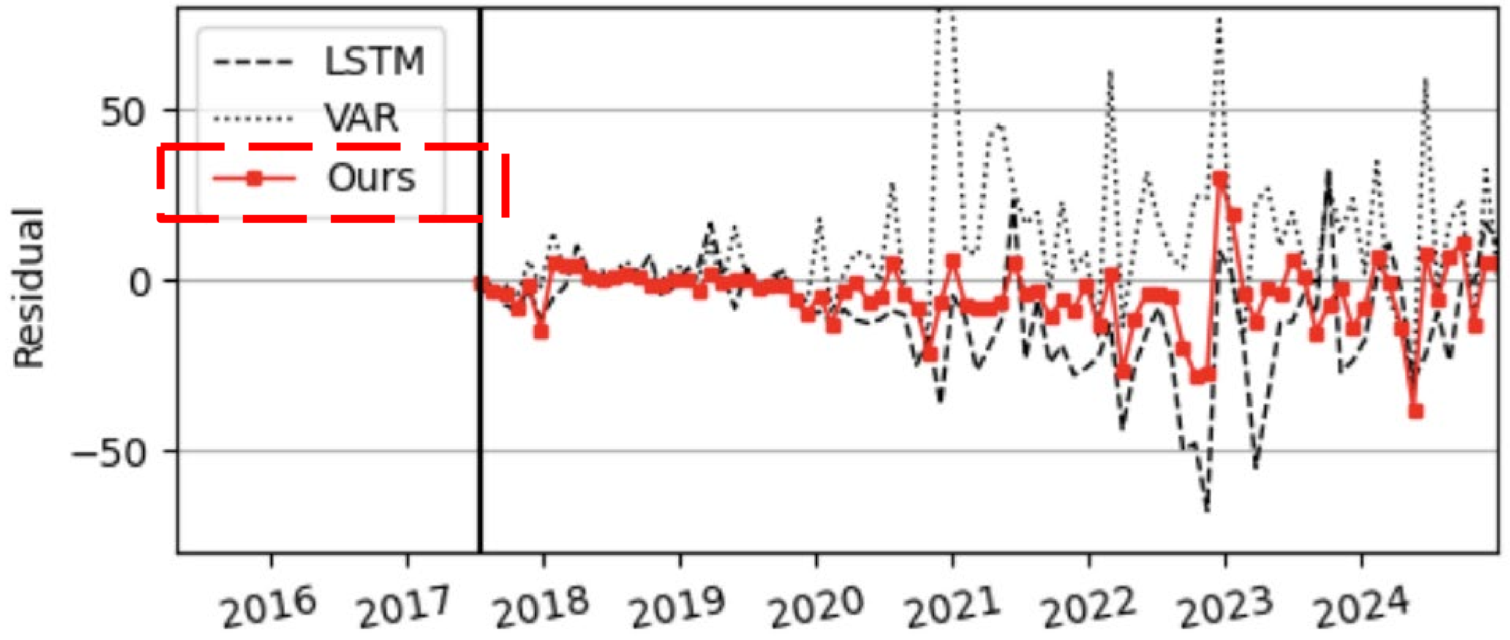
Evaluation

Our method (in red) outperforms other methods significantly regarding predictive error



PV Adoption Prediction Over Time



Prediction Error Over Time

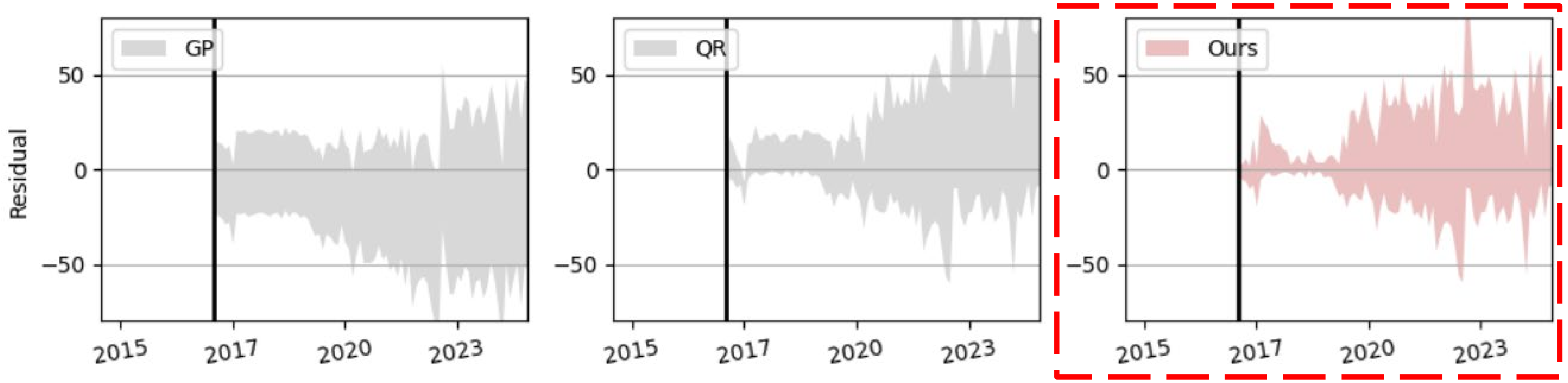
Method	Aggregated MAE	Regional MAE	Regional STD
PR	26.51	0.23	0.34
VAR	15.17	0.40	1.19
LSTM	14.96	0.21	0.37
Vanilla Hawkes	13.35	0.19	**0.31**
Covariate enhanced Hawkes	**12.59**	**0.18**	**0.31**

Prediction Error Comparison

Carnegie Mellon University aes Indiana

Evaluation

Our method (in red) achieves better uncertainty quantification (narrower prediction band)



Estimated Uncertainty Band Error Over Time Evaluation

Method	Full			Half		
	Val ↑	AggVal ↑	Size ↓	Val	AggVal ↑	Size ↓
LSTM	No (-)	No (-)	-	No (-)	No (-)	-
VAR	No (56%)	No (45%)	0.37	No (68%)	No (79%)	0.37
GPR	No (83%)	Yes (96%)	1.24	No (83%)	Yes (98%)	1.24
QFR	Yes (93%)	Yes (99%)	1.09	Yes (93%)	Yes (100%)	1.09
HST-Conformal	**Yes 99%**	**Yes 100%**	**1.06**	**Yes 99%**	**Yes 95%**	**0.77**

Uncertainty Band Validity (Probabilistic Coverage) and Efficiency (Size) Evaluation

2025 DSM market potential study introduction

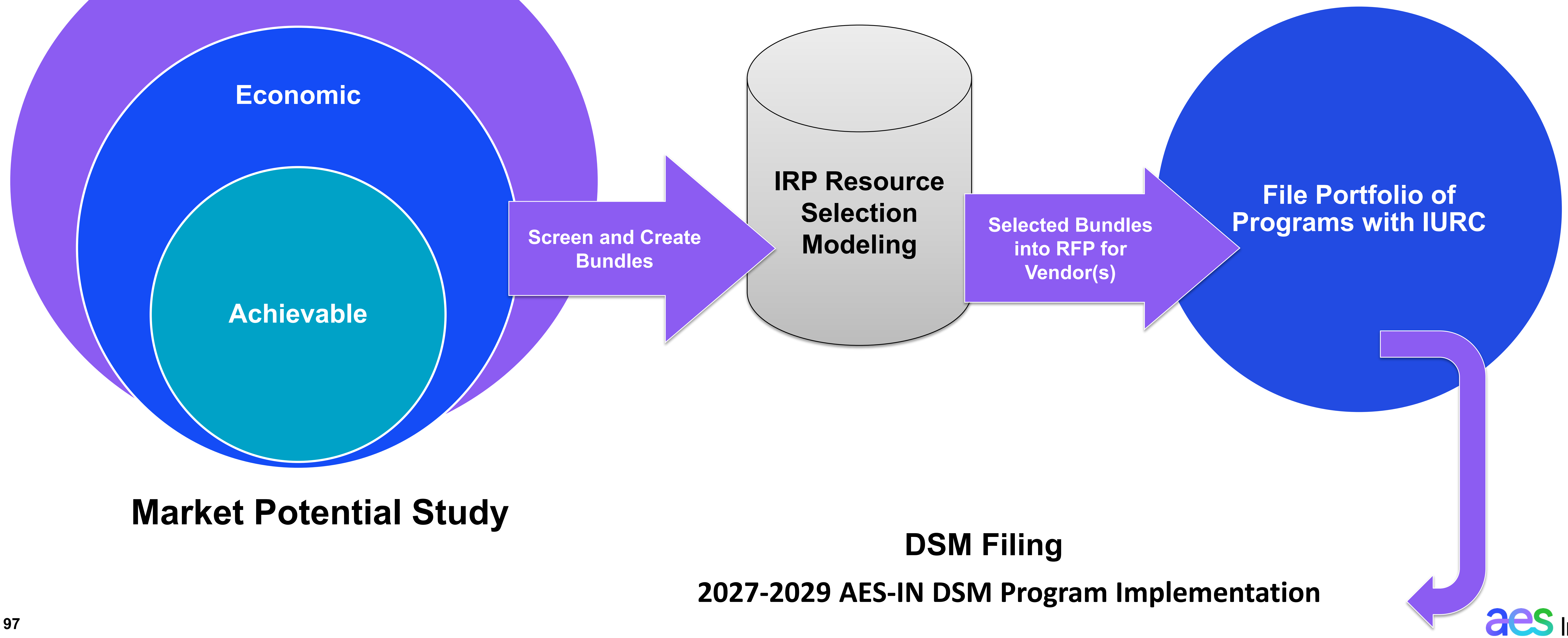
Jeffrey Huber, Overall Project Manager and MPS Lead, GDS Associates

2025 MPS Topic Areas

- **MPS Overview**
  - Past Studies and Scope Overview
  - Current Project Timeline
- **Market Research Activities**
  - End-Use Analysis
  - Additional Research
- **Energy Efficiency Overview**
  - Major Topic Areas and Activities
  - Methodological Considerations
- **Demand Response Overview**
  - Major Topic Areas and Activities
  - Methodological Considerations
- **IRP Inputs**

DSM overview: 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.”



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DSM overview: Past studies & current scope

→ **GDS completed prior market potential studies in coordination with the 2019 and 2022 IRP.**

→ **2025 MPS scope of work includes:**

- → End-Use Analysis & Primary Market Research
- → Secondary Market Research
- → Energy Efficiency Market Potential Study
- → Demand Response Market Potential Study
- → Electrification Analysis
- → DSM IRP Inputs

DSM overview: Deliverables overview

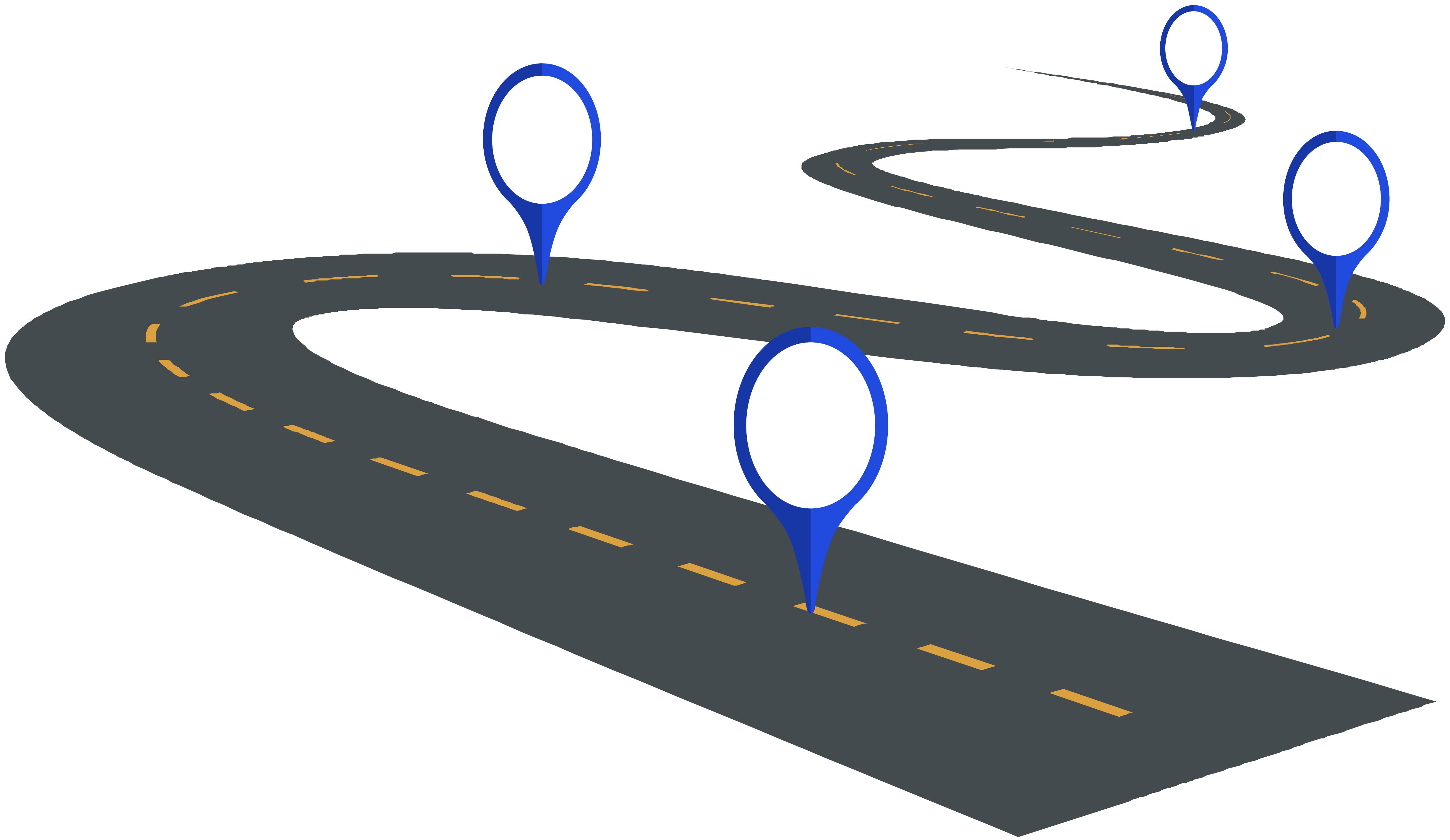
Anticipated Deliverables

- → Market Research Memo and Updated end-use indices used in future load forecasts
- → Energy Efficiency Market Potential Study
- → Demand Response Market Potential Study
- → DSM IRP Inputs

Items that are not an "outcome" of the DSM MPS:

- → IRP load forecast
  - → Used as an input into the DSM Market Potential Study
- → EV forecast
  - → Can be used to inform demand response potential of EV-related programs
- → PV forecast
  - → Can be used as an input to inform potential for battery storage programs
- → Utility-sponsored electrification programs
  - → Fuel-switching not directly considered, but GDS is looking at naturally-occurring electrification and impact to the load forecast

DSM overview: Project timeline



→ **End-use analysis**
  → In field: January 2025
  → Result: February 2025
→ **EE MPS**
  → Draft results: March 2025
  → Final results: May 2025
→ **Demand response**
  → Draft results: March 2025
  → Final results: May 2025
→ **IRP inputs:**
  → Draft: April 2025
  → Final: May 2025

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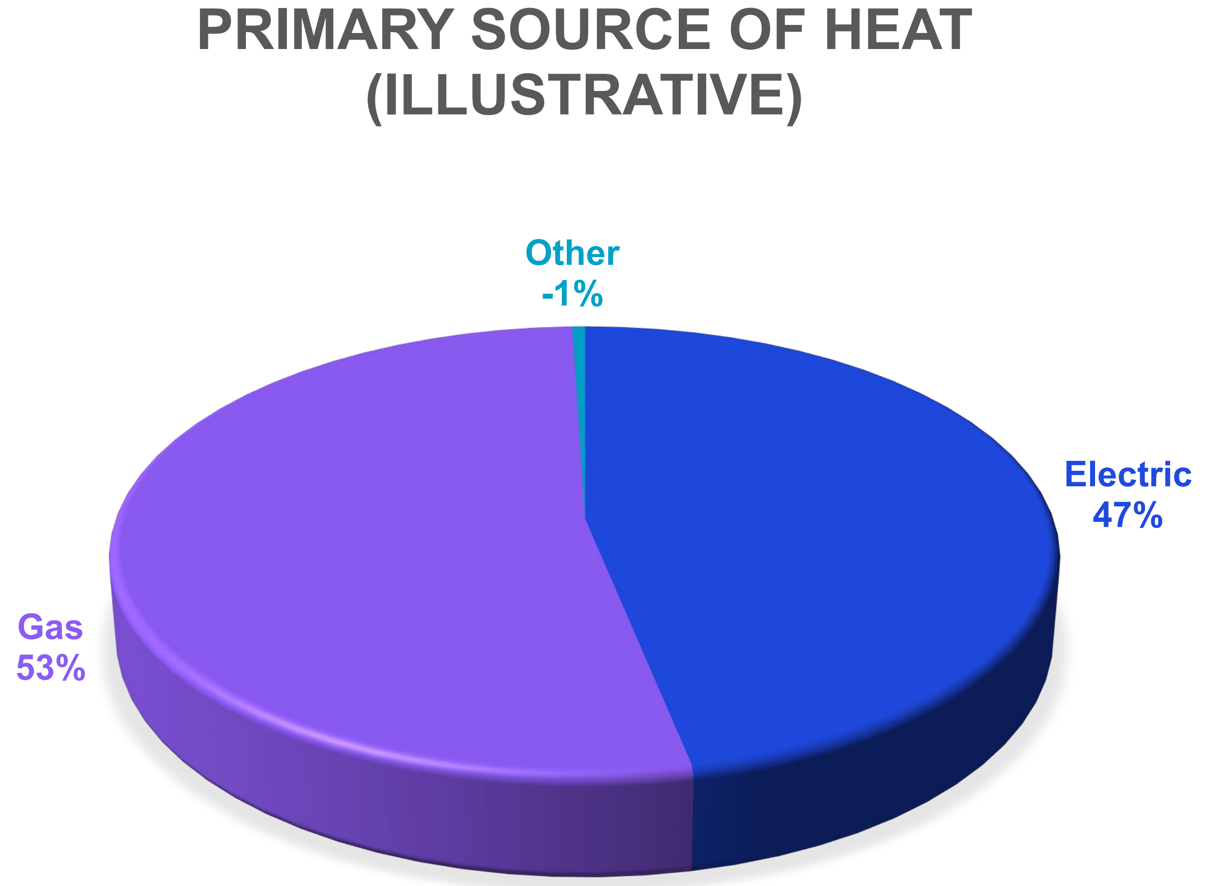
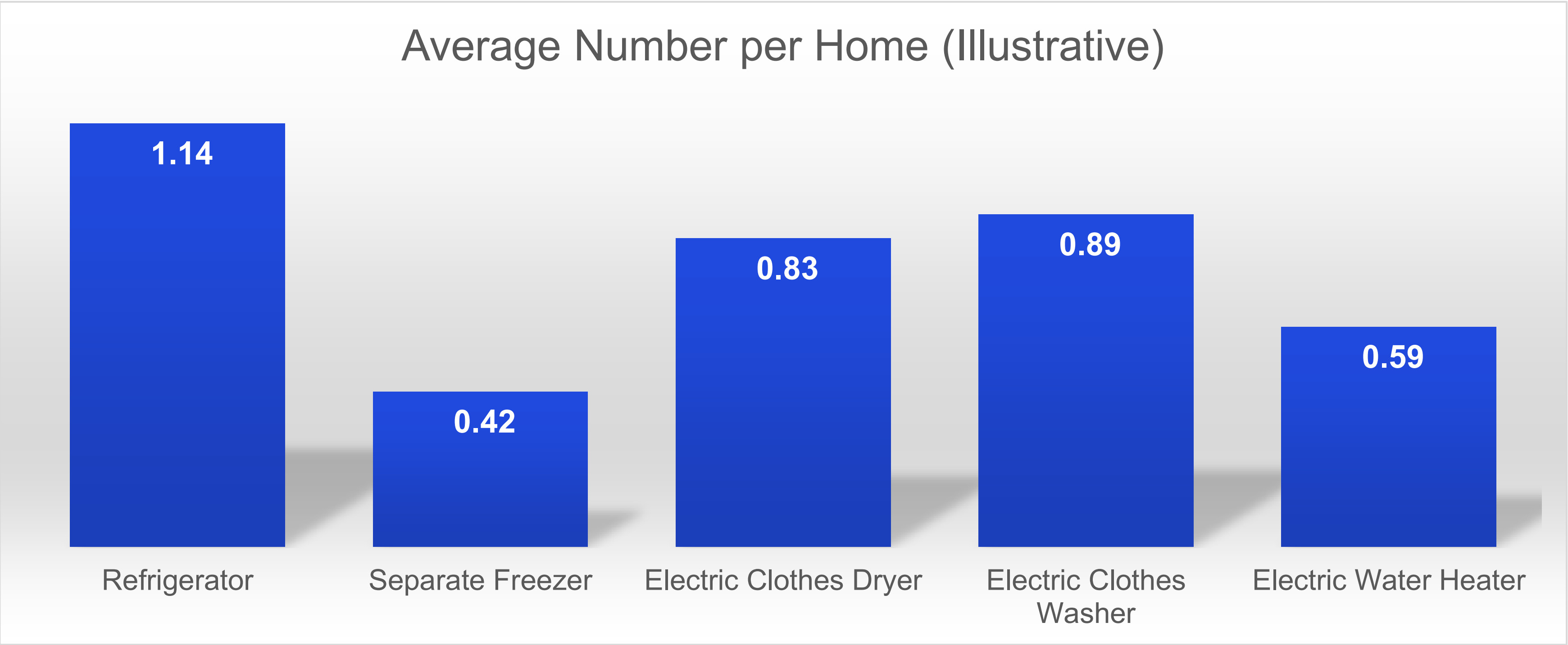
Market research: End-use analysis

- **Research to improve upon inputs typically used in both the AES Indiana load forecast and the GDS Market Potential Study**
  - Includes both primary and secondary market research
  - Email recruitment and on-line survey
- **Residential**
  - End-use market share
  - Unit energy consumption
- **Small Commercial & Industrial**
  - End-use Intensity
  - Distribution of customers by building type
  - End-use saturation

Market research: End-use analysis (cont'd)

- → **Data collection elements limited to items that may be answered accurately**
- → **Residential survey will collect:**
  - → Ownership, age, and count of electric end-use equipment across major end-use categories
  - → Information on smart appliances and electric vehicles
- → **Nonresidential survey will focus on:**
  - → Key end-uses: lighting, cooling, heating, ventilation, water heating, refrigeration
  - → Key equipment penetration
  - → Limited efficiency saturation (LEDs, controls)





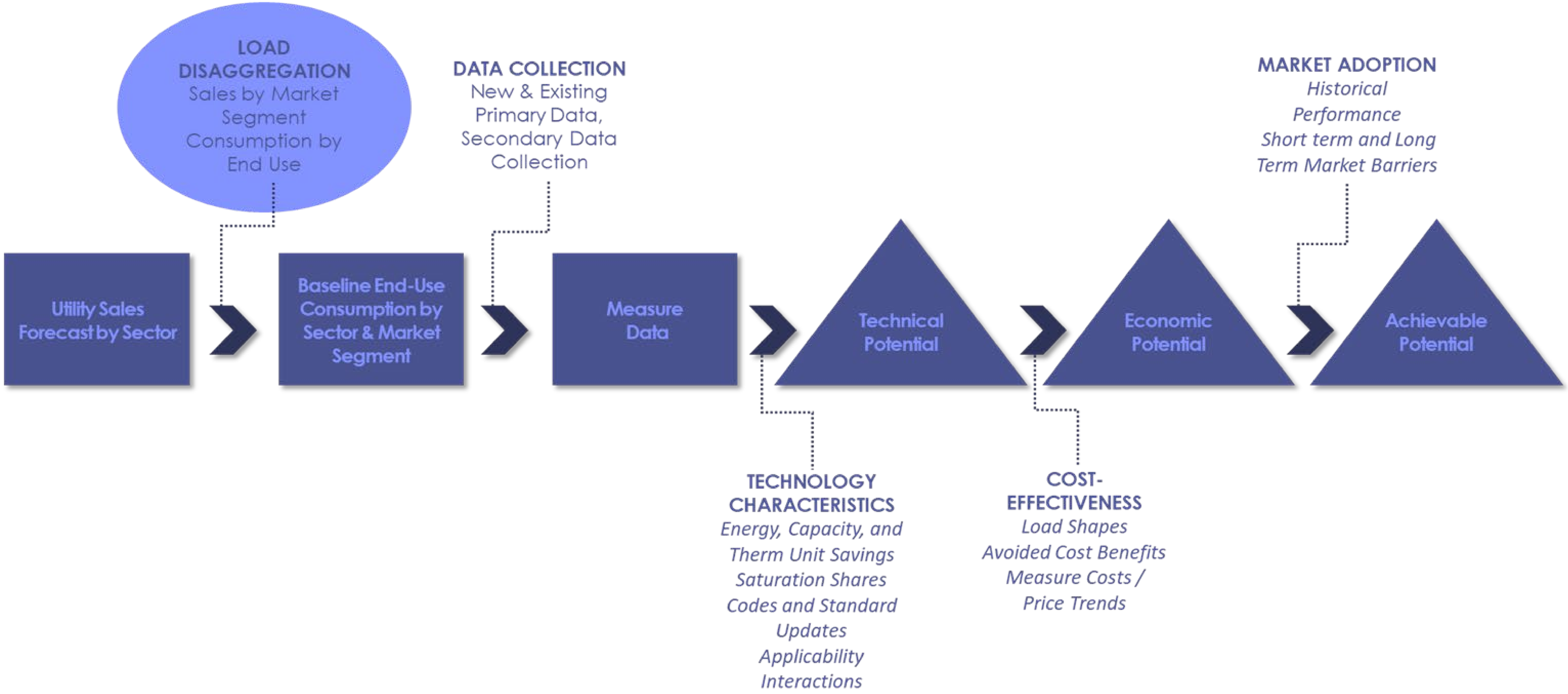
Market research: Survey samples

Market Segment	Sample Design	Sample Frame	# of Responses	Response Rate
Total Residential Population	95/5 Design = 391 Responses	15,320 (100%)	TBD	TBD%
Multifamily Homes	90/10 Design = 109 Responses	4,359 (28%)	TBD	TBD%
Single Family Homes	282 Responses	10,961 (72%)	TBD	TBD%
Nonresidential	90/10 Design >70 Responses	7,840	TBD	TBD%

Market research: Additional survey efforts

- **The 2022 MPS market research included a willingness-to-participate (WTP) survey to collect consumer awareness and willingness to participate in various programs or purchase various equipment, such as:**
  - EE Equipment (HVAC, Hot Water, Appliances, Lighting)
  - DR Programs (AC Cycling, TOU Rates)
  - Electric Vehicles/Solar PV
- **GDS has collected similar research in other nearby jurisdictions with minimal differences across respondents.**
- **For the 2025 MPS we intend to offer a WTP survey that collects additional information on:**
  - Additional demand response opportunities
  - Potential impacts of other funding sources (ex. IRA funds)
  - Additional Distributed Energy Resource opportunities (that might not directly tie to the MPS, but could be useful future information to AES-IN initiatives)

EE overview: Flow chart



EE overview: Data input needs

- **Starts with a utility data request to understand:**
  - Timeframe of the analysis
  - Current utility sales forecast projections and sales by customer/industry codes
  - Current avoided costs of energy, capacity, transmission/distribution
  - Global economic inputs (inflation rate, discount rate, reserve margin requirement, line losses)
  - Current program/measure offerings
  - Current incentive levels and other program costs
  - Current participation levels and EM&V results
  - Any relevant DSM policy considerations

EE Overview: Market Data

→ **Understanding the load forecast**

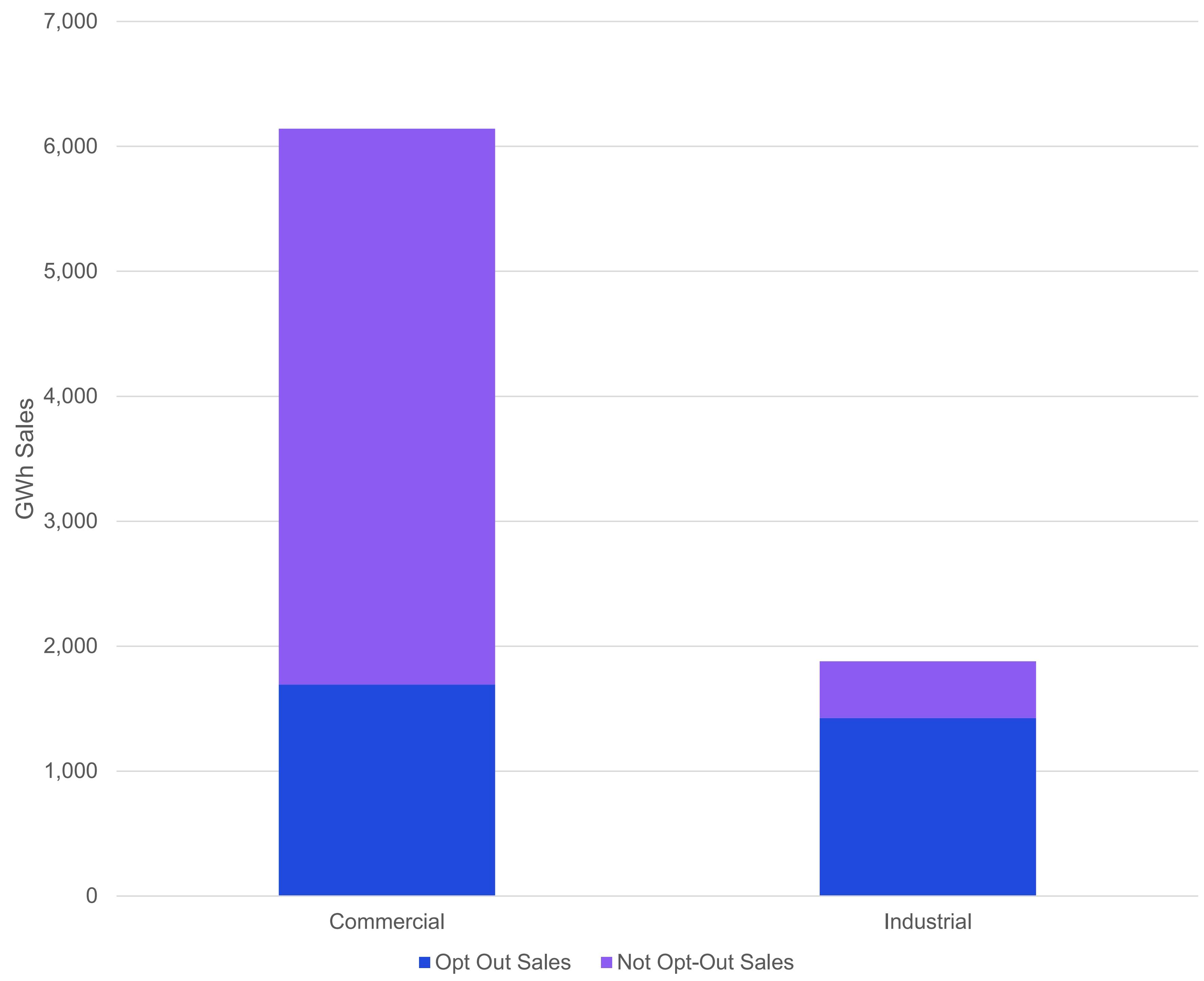
- → Sales and Customer Counts
- → Residential (single family/multifamily ; market rate/income qualified)
- → Commercial (by building type)
- → Industrial (by industry type)

→ **Understanding eligible sales**

- → Percentage of sales from "opt-out" customers
- → Percentage of sales from other "atypical" facilities with limited traditional EE opportunities

→ **Understanding consumption by end-use**

Illustrative example of opt-out sales (from 2022 AES-IN Market Potential Study



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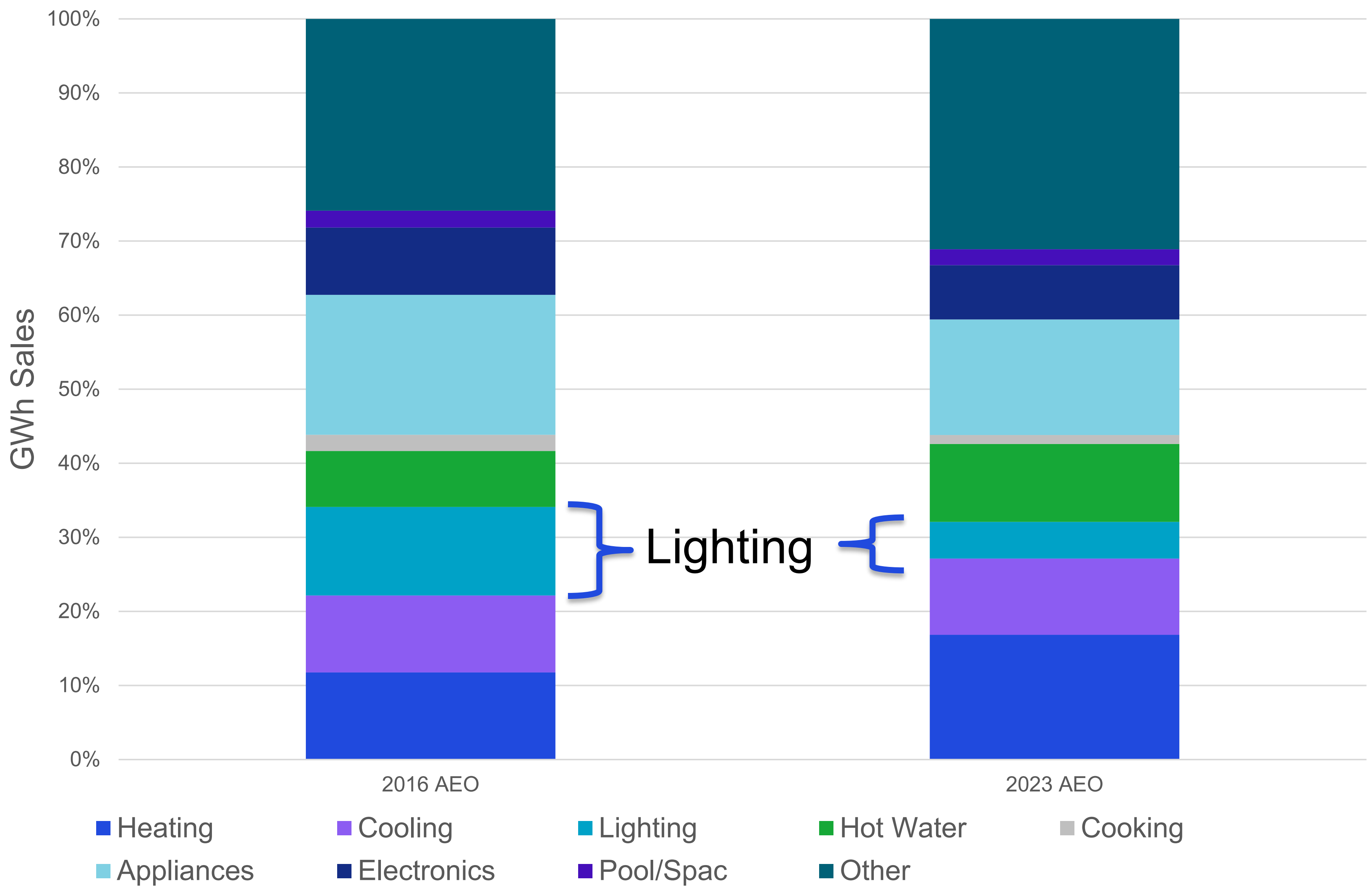
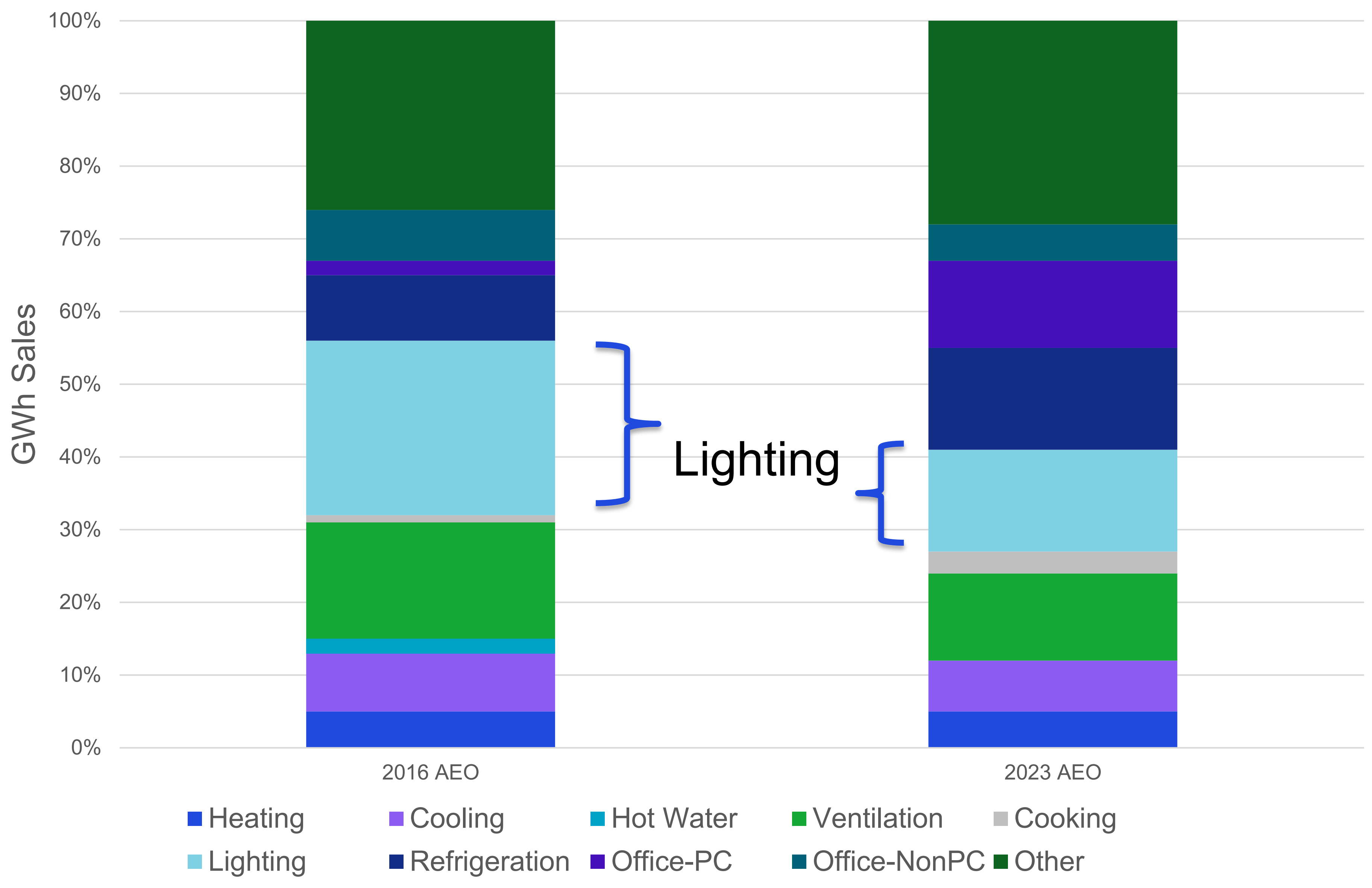
EE overview: Market data (cont'd)

In addition to changes in equipment stock, we also look to incorporate impacts that equipment standard changes have had on consumption.

Illustrative example residential end-use consumption (2016 AEO vs 2023 AEO)



Illustrative example commercial end-use consumption (2016 AEO vs 2023 AEO)



EE overview: Measure data

- **Develop an AES-Indiana specific measure database of:**
  - Measure Savings (Annual Savings & Peak Demand Savings)
  - Measure Effective Useful Life (EUL)
  - Measure Costs (either full costs or incremental costs)
  - Measure Incentives

Derived primarily from the Indiana TRM w/ support from additional regional resources

- Base Saturation Estimates (i.e., % of homes with a specific type of equipment)
- EE Saturation Estimates (% of equipment that is already efficient)

Derived from a blend of primary market research and regional/national data sources

EE overview: Potential overview

TECHNICAL POTENTIAL

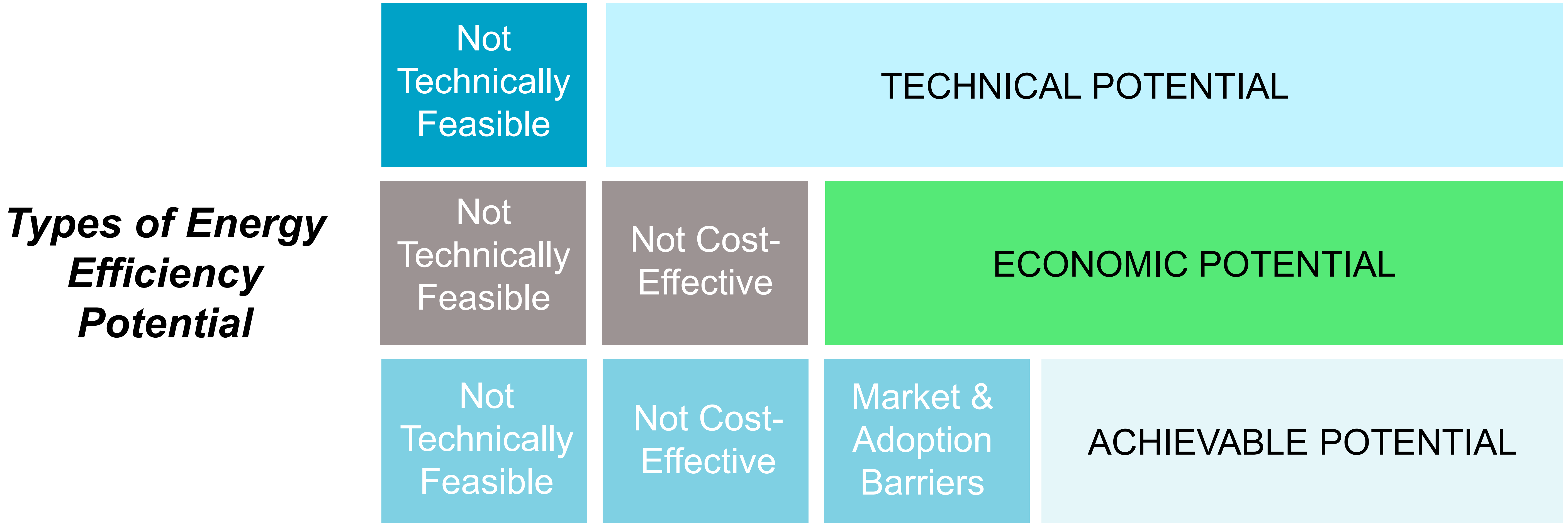
All technically feasible measures are incorporated to provide a theoretical maximum potential.

ECONOMIC POTENTIAL

All measures are screened for cost-effectiveness using the **Utility Cost 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.



EE overview: Estimating potential

RESIDENTIAL EQUATION

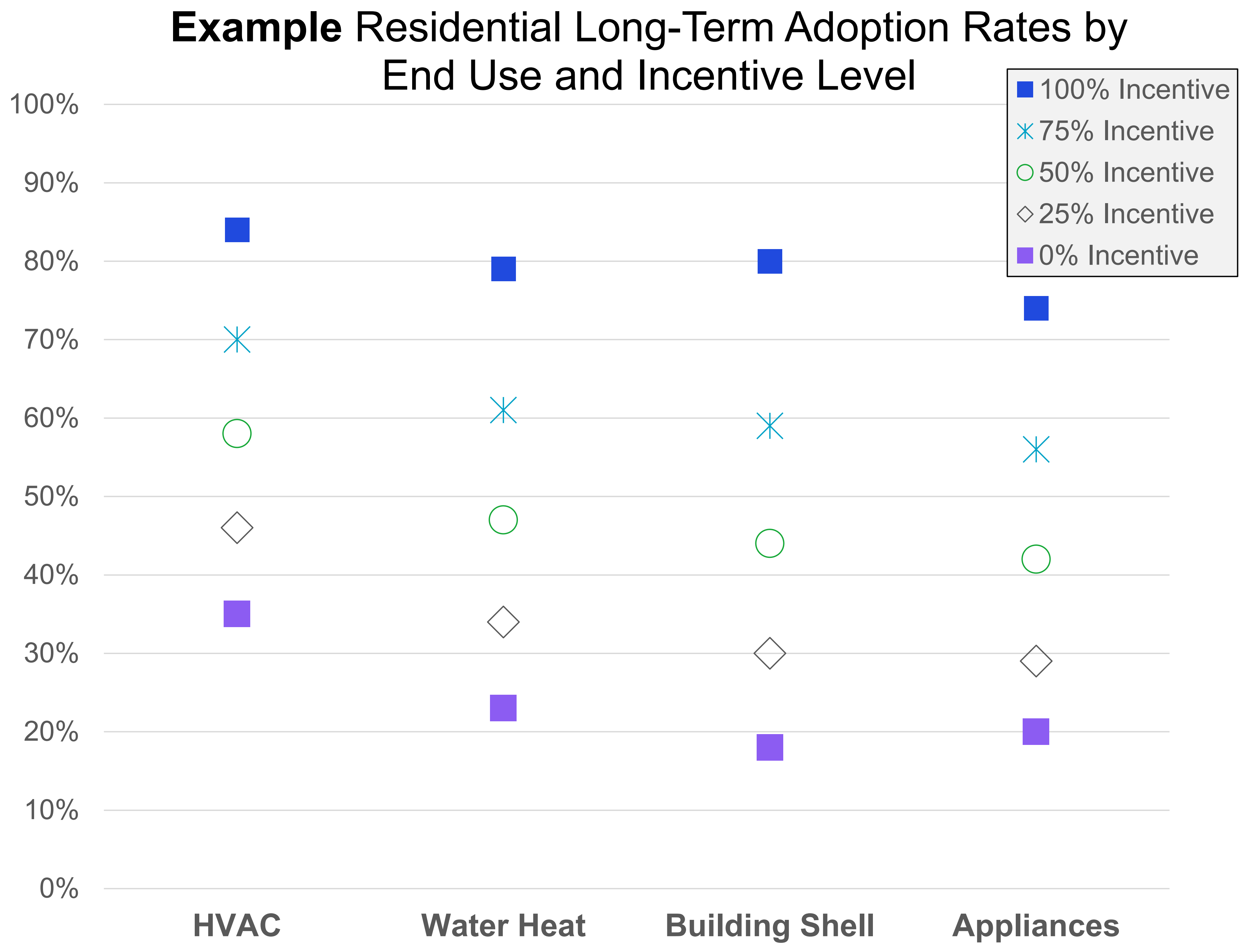
TECHNICAL POTENTIAL OF EFFICIENT MEASURES = Total Number of Households X Base Case Equipment End Use Intensity X Saturation Share X Applicability Factor X Savings Factor

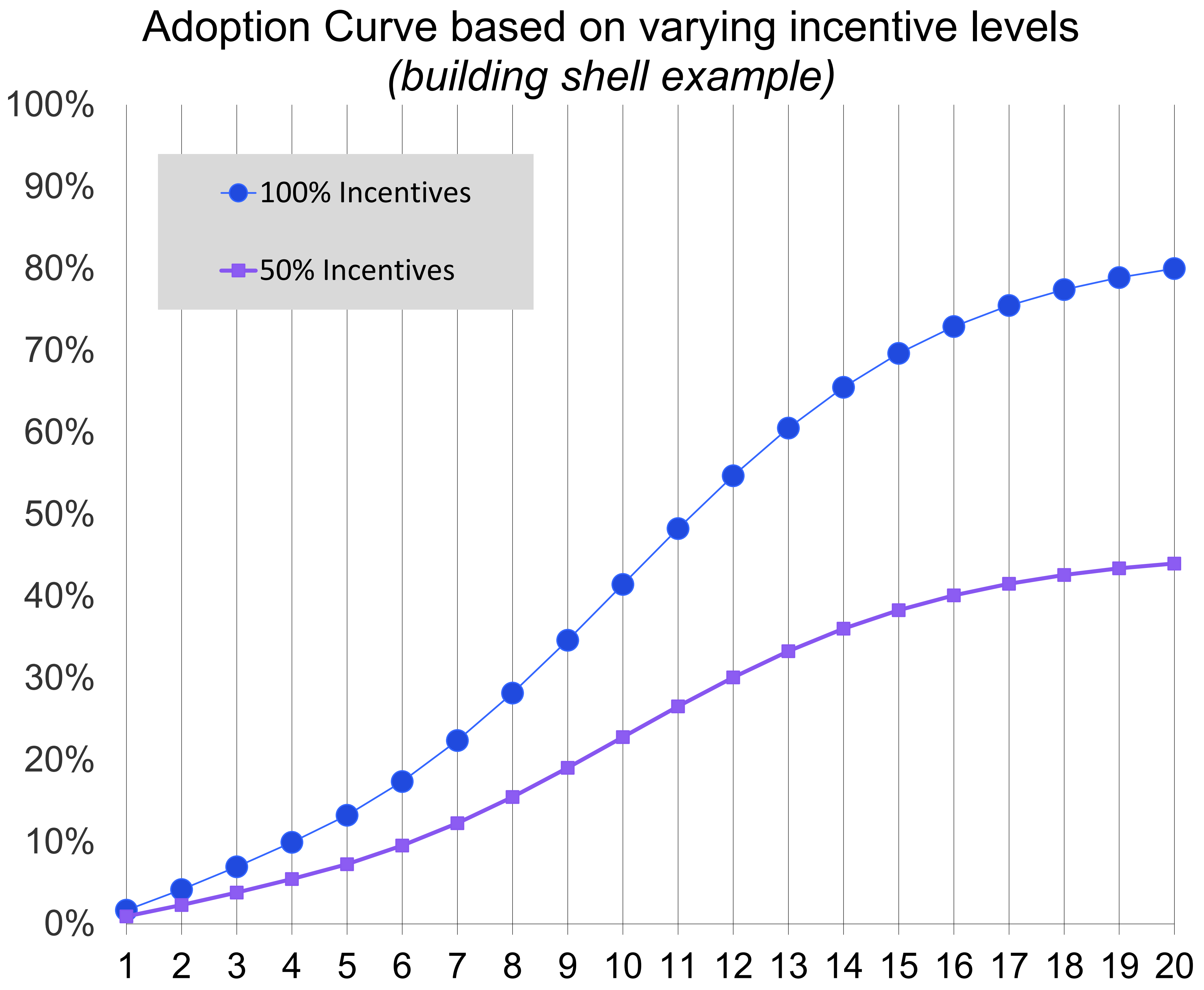
NON-RESIDENTIAL EQUATION

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

- → Residential sector uses a "bottom-up" approach based on total number of households
- → Commercial Sector uses a top-down approach that disaggregates sales by building type, end-use, and measure type
- → Industrial also is top-down and applies end-use level savings factors to end-use sales due to high variability of equipment in industrial sector

EE overview: Adoption rates





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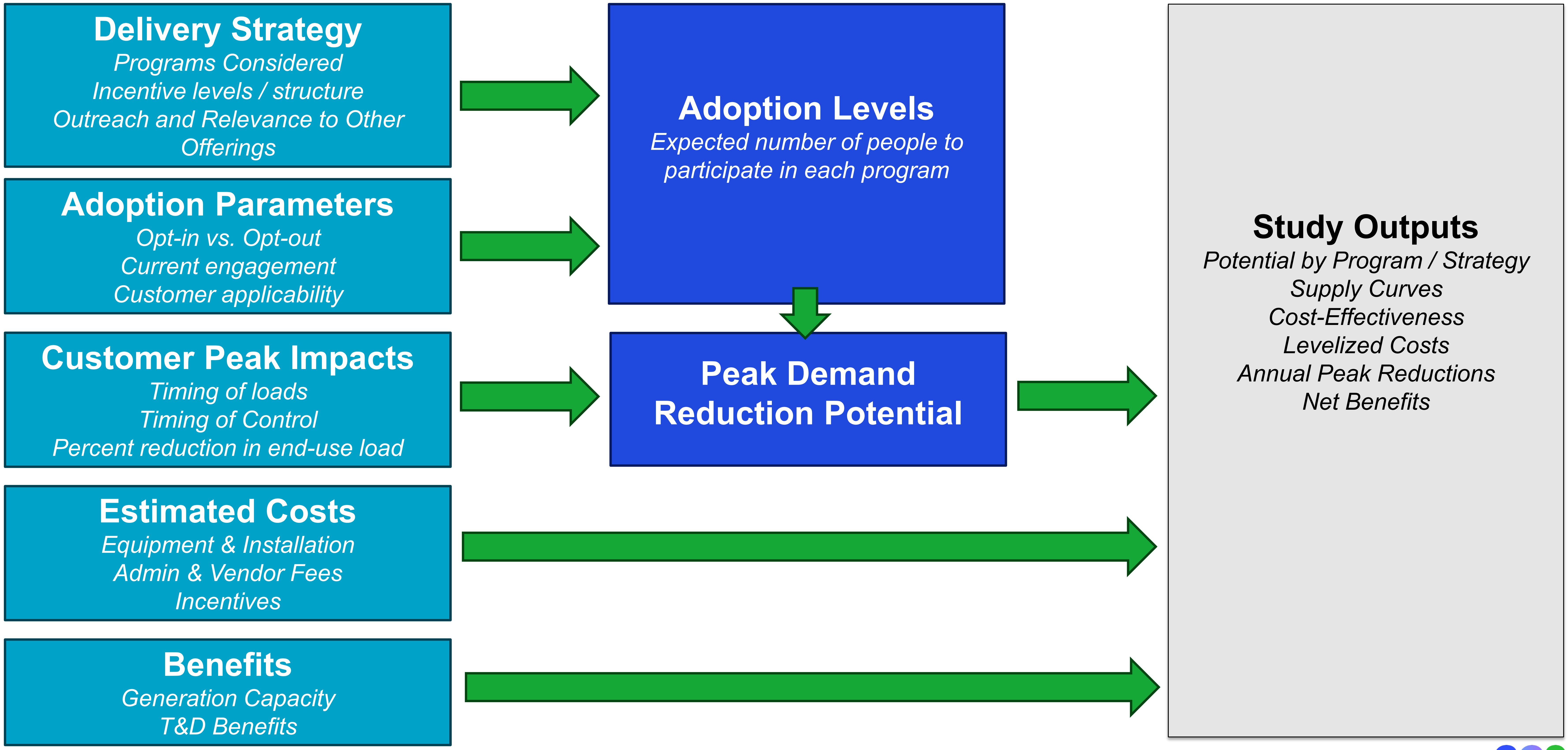
EE overview: EE MPS outputs

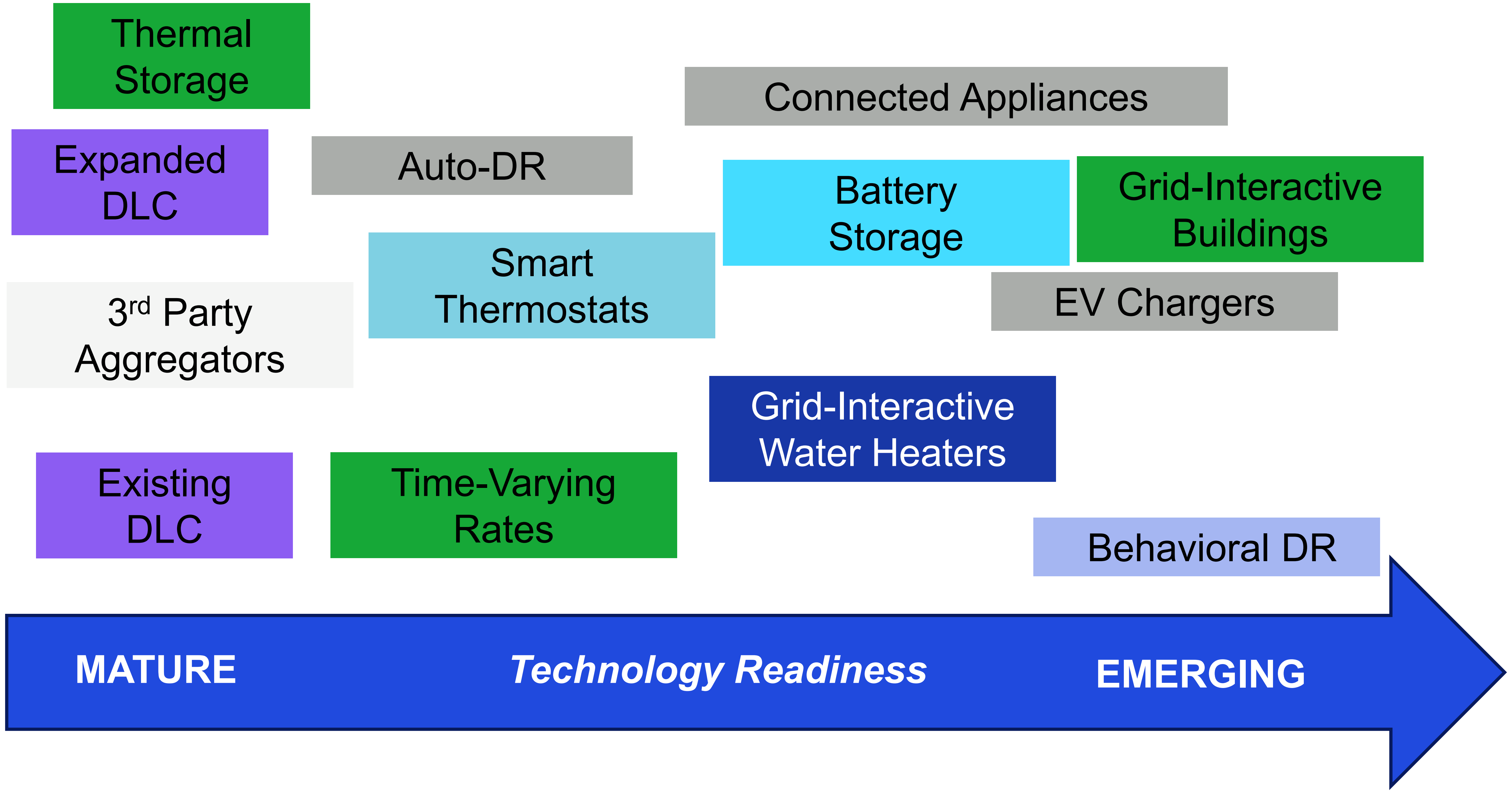
- → **Energy savings by potential type**
  - → Technical, Economic, Achievable, etc.
- → **Gross and net savings**
- → **Incremental annual and cumulative annual savings (MWh) by:**
  - → Sector
  - → Home/Building Type
  - → Income Type
  - → End Use
  - → Program
- → **Incremental and cumulative annual demand savings**
  - → By Season
- → Annual incentive and non-incentive costs
- → Annual NPV benefits and UCT ratios
- → Levelized costs of energy efficiency and supply curves
- → Top program measures
- → Top non-program measures

DR overview: Potential overview



DR overview: Programs considered

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

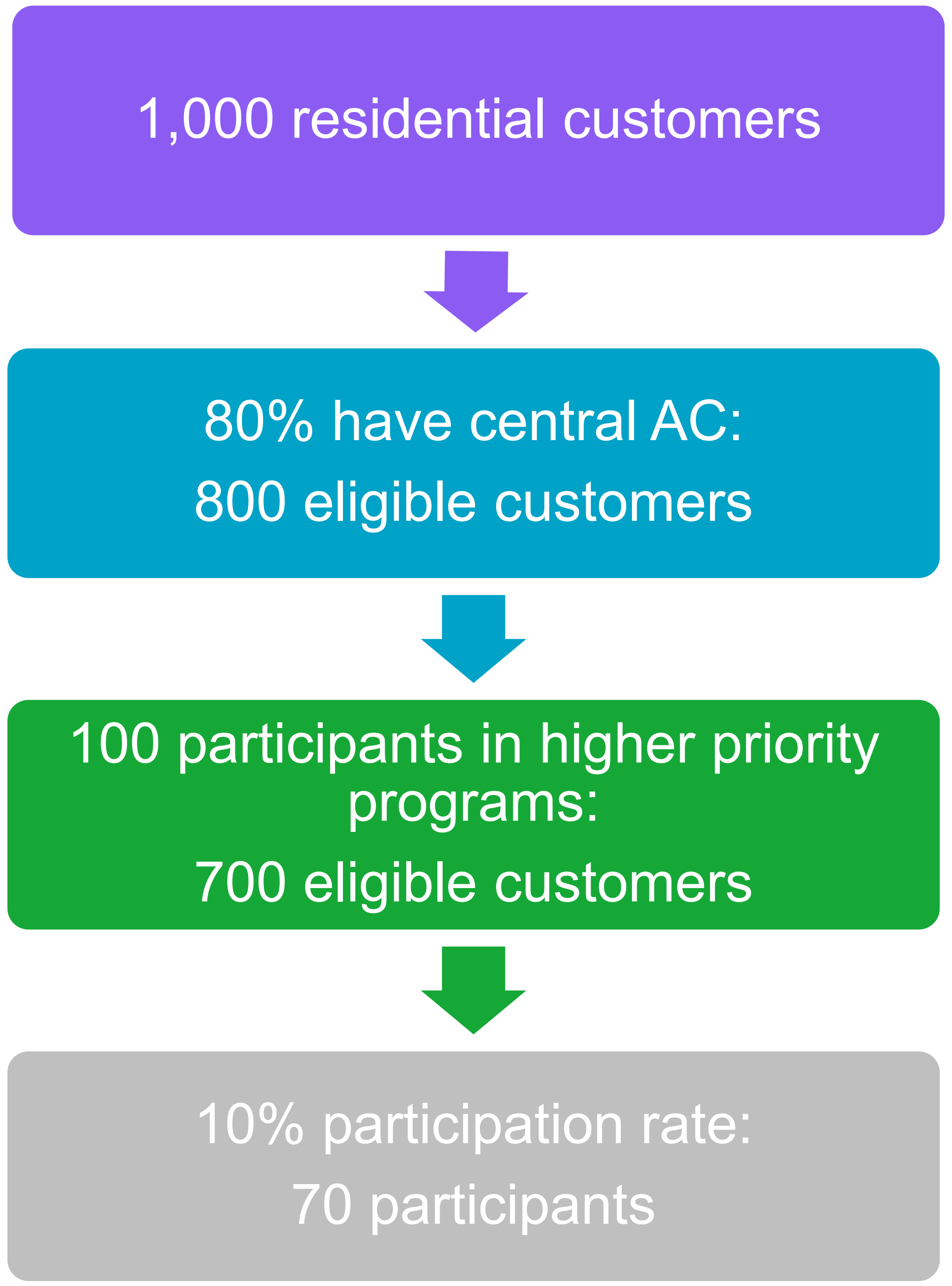


DR overview: Estimating participation

→ Eligible customers are those with the appropriate end use for a program (e.g., those with central AC for an AC control program).

→ A hierarchy is used to prevent double-counting of savings from programs that affect the same end uses. It is assumed for this study that customers cannot participate in multiple programs that affect the same end uses. Participants of higher priority programs are subtracted from the eligible market for the lower priority programs.

→ Market research and secondary research will help develop participation rates, which simulate the rate at which participants can be attained over the period of the study. These participation rates are applied to the eligible customers for each program.



Example of how participation is calculated

DR overview: Determining peak load potential

→ Analysis will be conducted using GDS Demand Response Model (DR Model). The model considers approximately 50 required inputs, including expected life of equipment, coincident peak kW load reductions per customer, proposed incentives, and program related expenses.

→ Utility-specific data on avoided costs, line losses, and discount rates will be incorporated. The primary benefit of DR is avoided generation capacity but also includes considerations for avoided transmission and distribution benefits.

→ The DR model determines cost-effectiveness using a variety of tests, such as UCT and TRC, as well as the estimated potential demand savings for each program.

→ Potential savings will be estimated for each season, dependent on both per participant reduction estimates as well as customer participation/eligibility across seasons.

Electrification overview: Analysis approach

- → **It's different from market potential study in that it does not examine utility intervention for fuel-switching.**
  - → Similar analysis was performed for 2022 MPS/IRP.
- → **The analysis will look at the updated economics of electrification for key building technologies (heat pumps, water heating, clothes dryers) to understand overall benefits and costs.**
- → **The analysis will utilize a bass diffusion to estimate a range of possible outcomes.**
  - → Calibrate curves based on known historical adoption information and market research
  - → If possible, use data from WTP and customer attitudes on impacts of federal funding on future electrification adoption levels
  - → Account for building electrification effects already present in the baseline forecast
- → **The analysis will help determine whether any adjustments to the load forecast to account for future electrification is appropriate.**

Electrification overview: Results from 2022

Scenario	2023	2025	2030	2035	2040	2042	Percent Above Base Rate Forecast
Low	8,910	16,954	52,983	109,200	163,058	187,904	1.3%
Medium	10,709	22,653	74,905	181,388	301,705	347,890	2.4%
High	12,727	29,661	111,370	329,653	598,830	654,627	4.4%

→In a 2022 study, additional load due to electrification provided a range of 1.3% to 4.4% above the AES base forecast.

→As a comparison, NREL's Electrification Futures Study Reference Case was modeled as showing 0.9% growth above the base forecast by 2042.

DSM in the IRP: Expected input structure

DSM inputs are currently proposed to be:

- → Sector based (residential, income-qualified, and nonresidential)
  - → Residential and non-residential will be selectable resources; income-qualified will be a “going-in” resource
- → Three time-vintages (2027-2029, 2030-2032, and 2033-2045)
- → Based on RAP and/or “Enhanced” RAP (to be defined later)
- → Based on net savings
- → Costs will reflect utility incentive and non-incentive costs (less NPV T&D benefits)
- → Include hourly profiles for each bundle

Final Q&A and next steps

Public Advisory Meeting

Public Advisory Meeting #1	Public Advisory Meeting #2	Public Advisory Meeting #3	Public Advisory Meeting #4	Public Advisory Meeting #5
Jan. 29, 2025	**Mar/Apr 2025**	**Jun/Jul 2025**	**Aug/Sep 2025**	**Oct 2025**

- All meetings will be available for attendance via Teams. Meetings in 2025 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

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

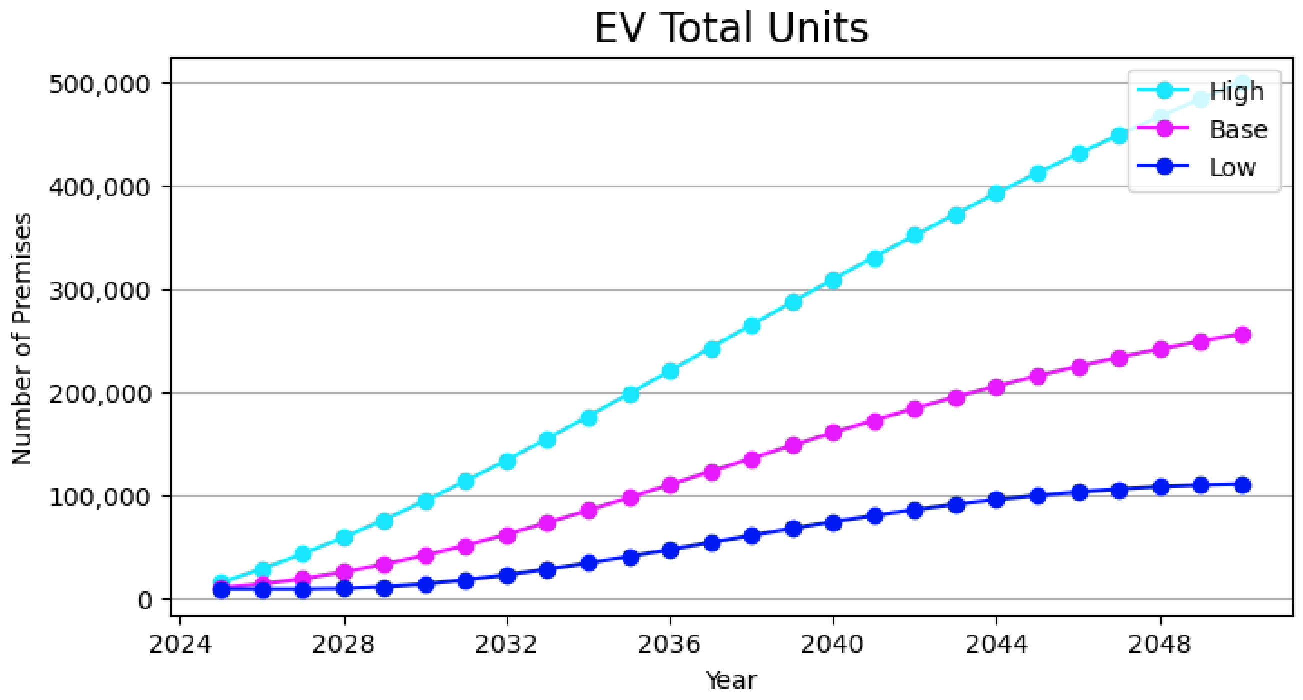
APPENDIX

Short-term action plan progress

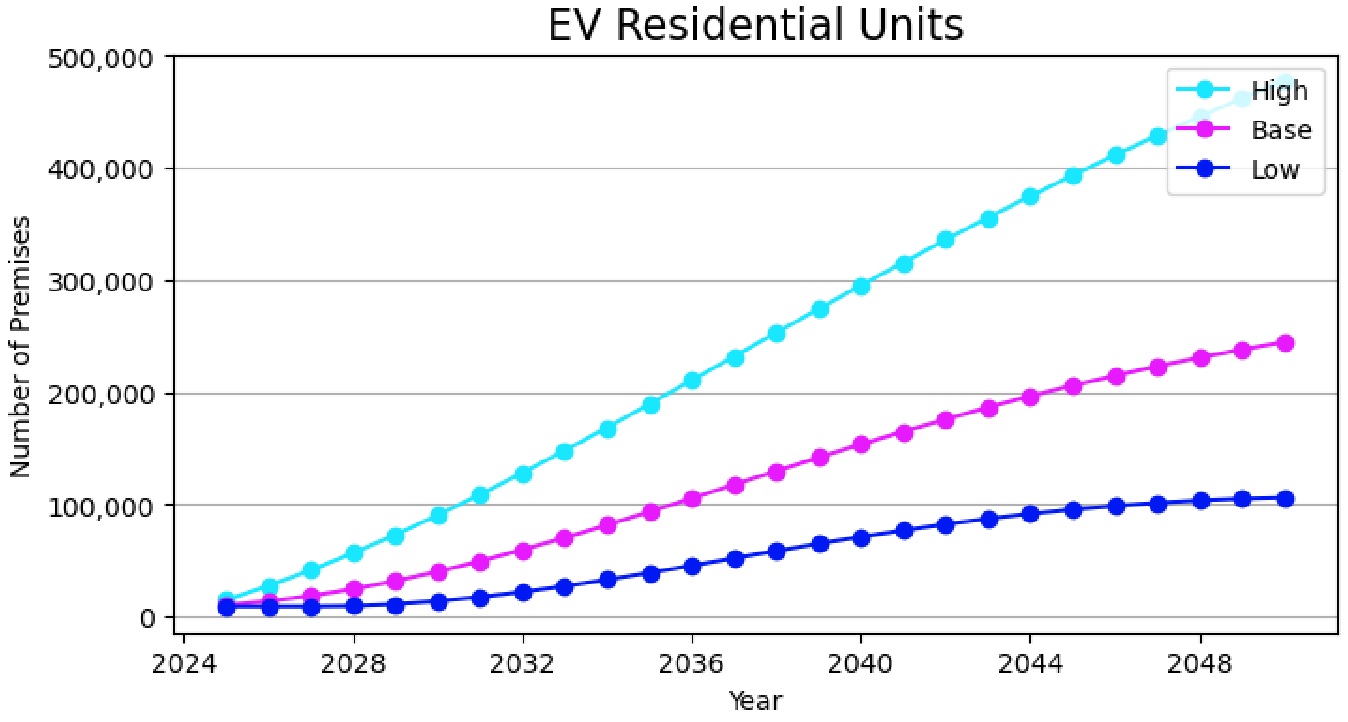
- **June 2023 - July 2024** – AES Indiana issues & evaluates all-source RFP for approximately 1,000 MW of firm capacity in 2023 to fill capacity need identified in 2022 IRP.
- **January 2024** – AES Indiana receives IURC Order approving the CPCN for Pike County Battery Energy Storage (200 MW) evaluated through the RFP process. Project estimated COD Q1 2025.
- **November 2024** – AES Indiana receives IURC Order approving the CPCN for repowering Petersburg Units 3 & 4 from coal to natural gas. Project estimated completion – Unit 3 repowered in first half of 2026; Unit 4 repowered in second half 2026.
- **Expected in Q2 2025** – AES Indiana anticipates IURC Order approving the CPCN for the Crossvine Solar + Storage project (85 MW solar; 85 MW 4-hr battery) identified through the RFP process. Project estimated COD June 2027.
- **January 2025** – AES Indiana receives IURC Order for the implementation of DSM programs in 2025-2026. DSM portfolio will target approximately 130,000 MWh of net savings per year or ~1.1% of forecasted sales.

Appendix: EV Prediction

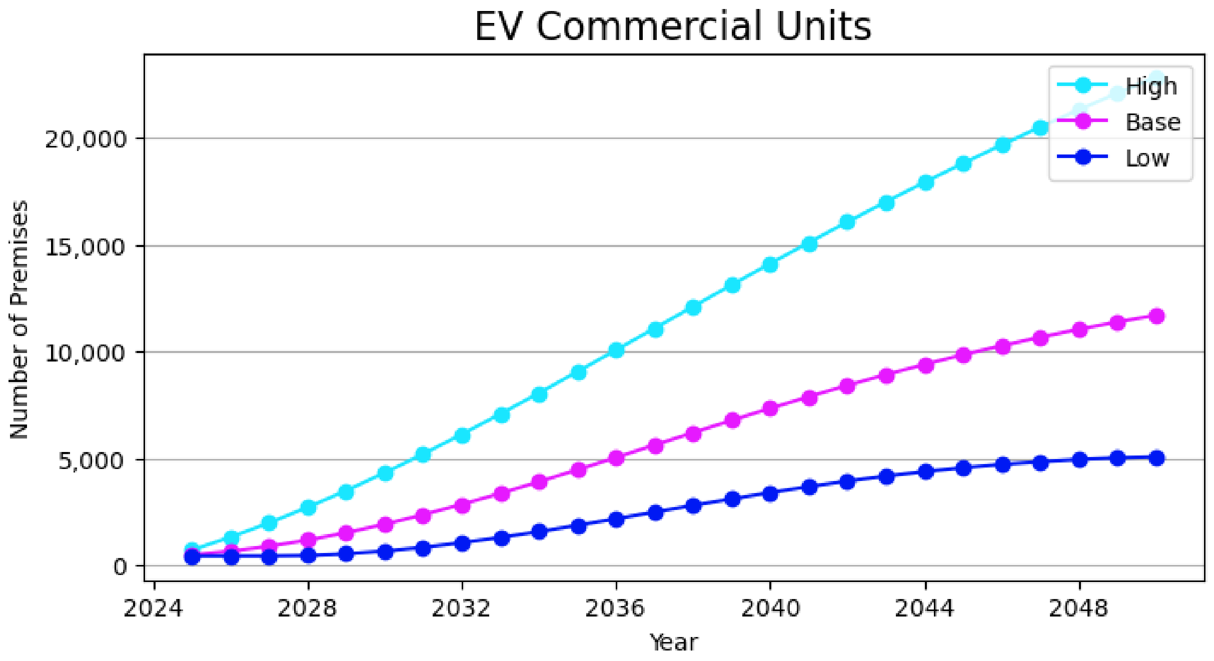
110k~500k



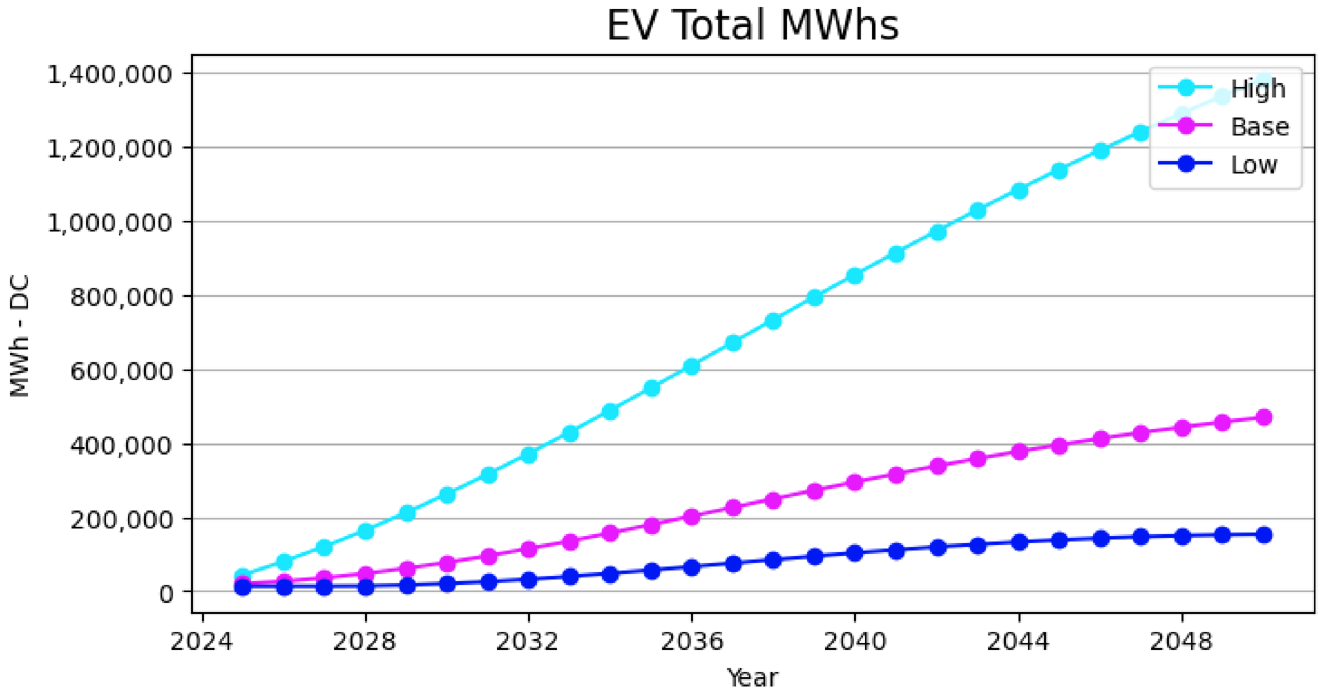
100k~480k



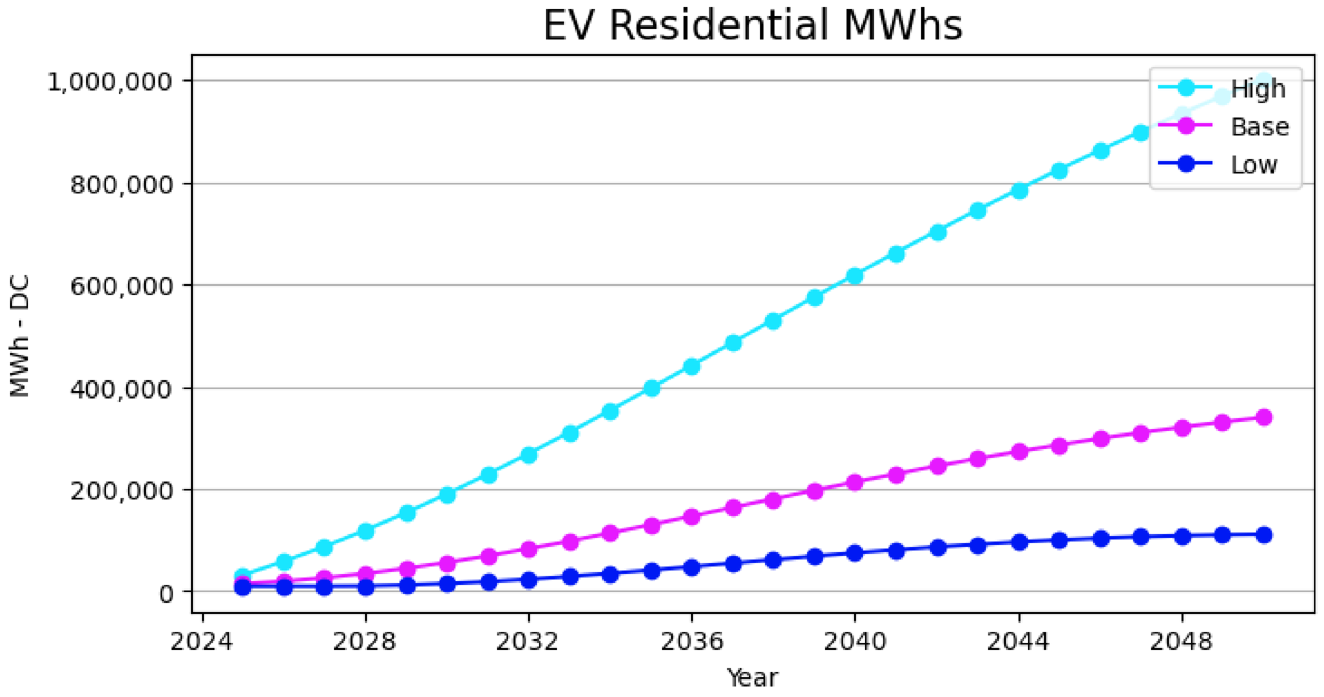
5k~22k



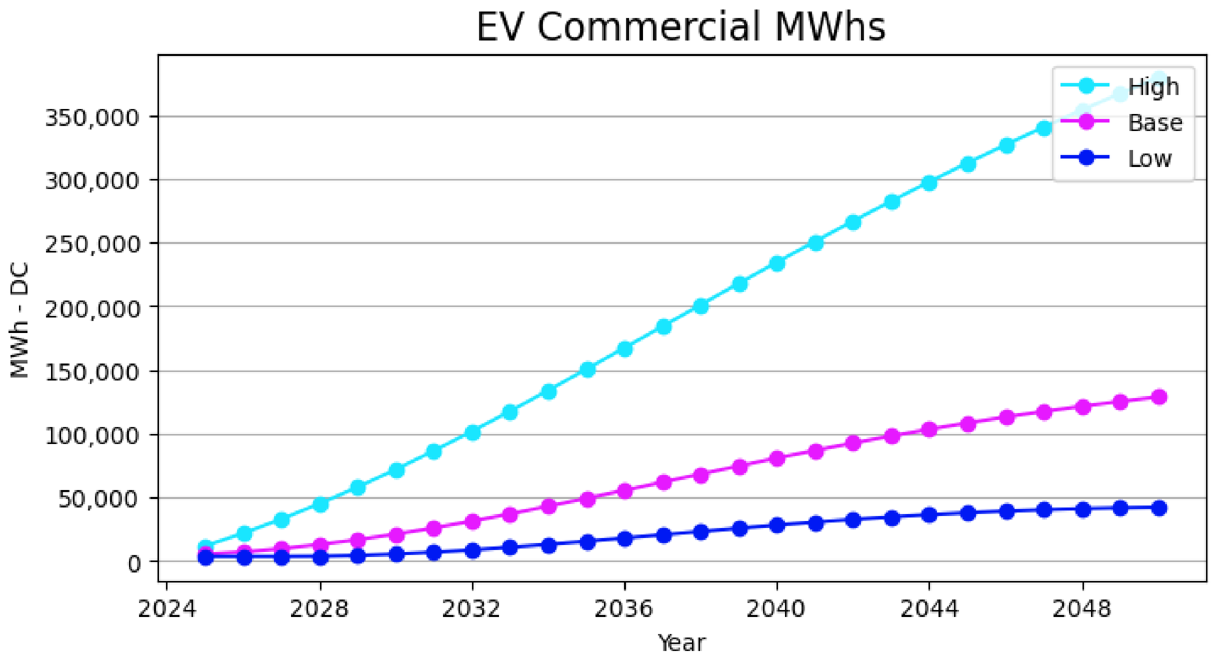
0.2M~1.4M



0.1M~1M



0.05M~0.4M



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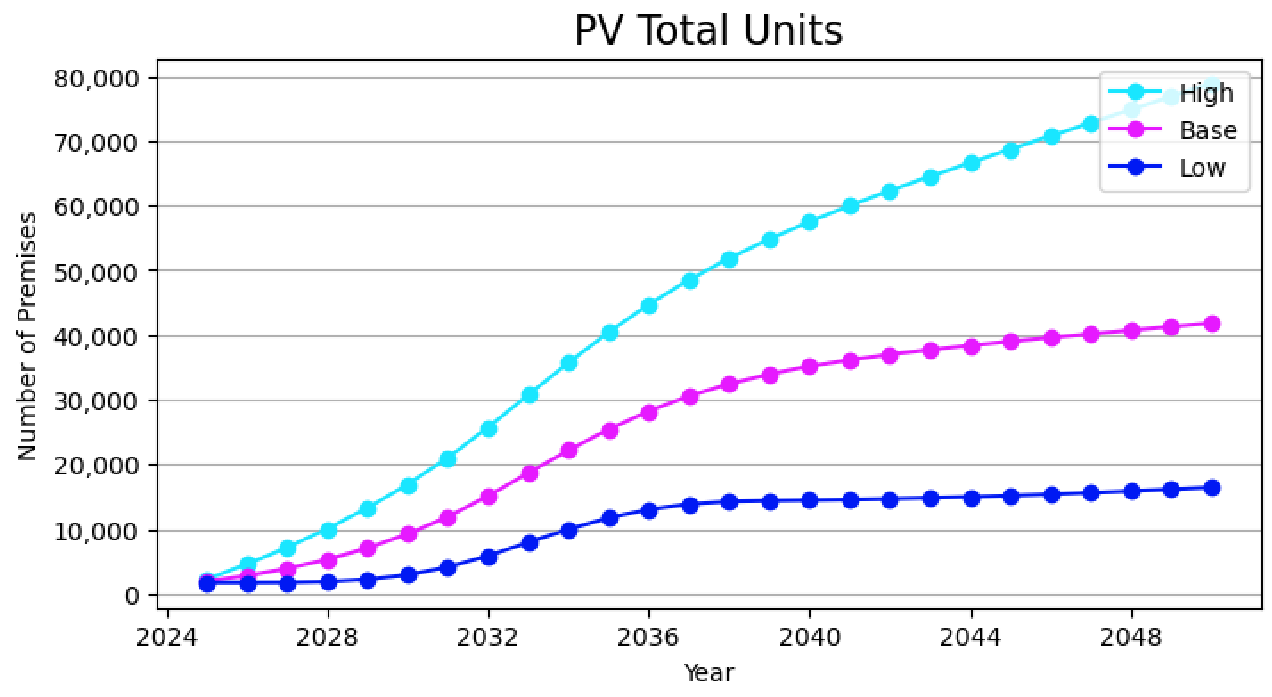
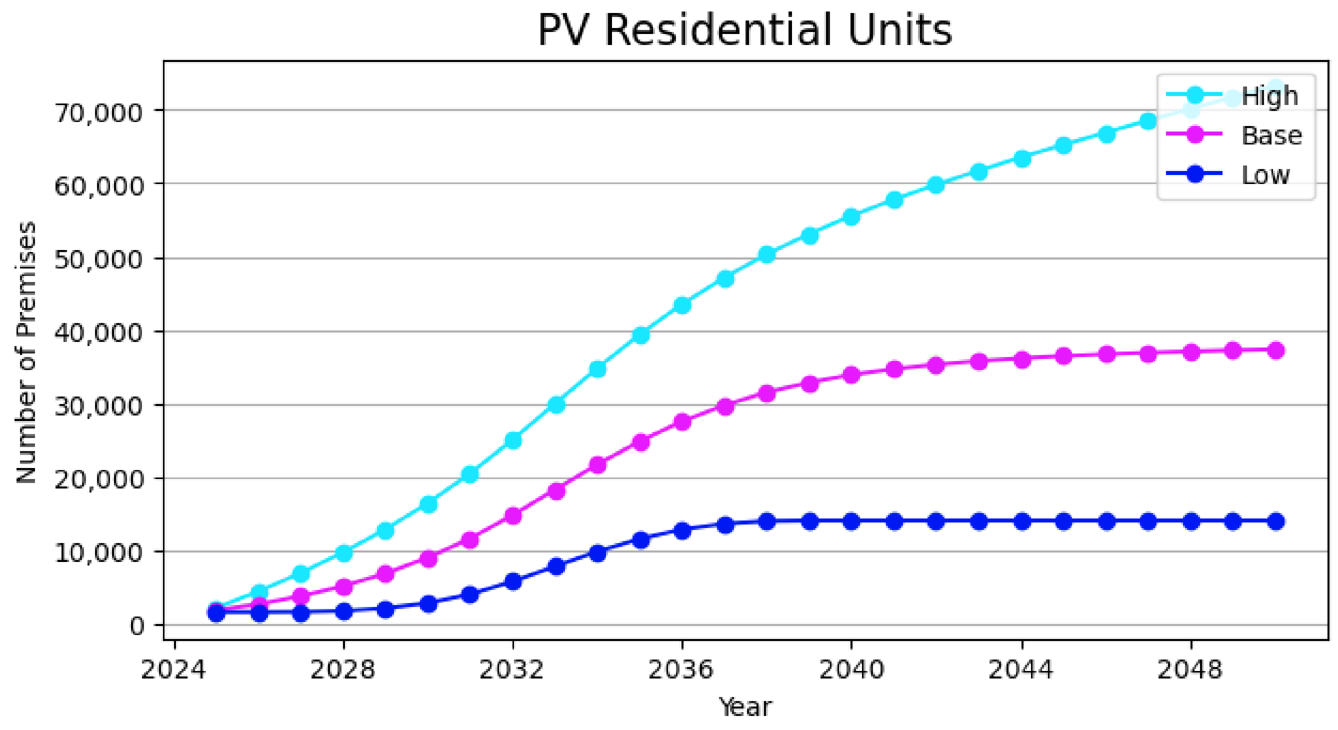
Appendix: Customer solar prediction

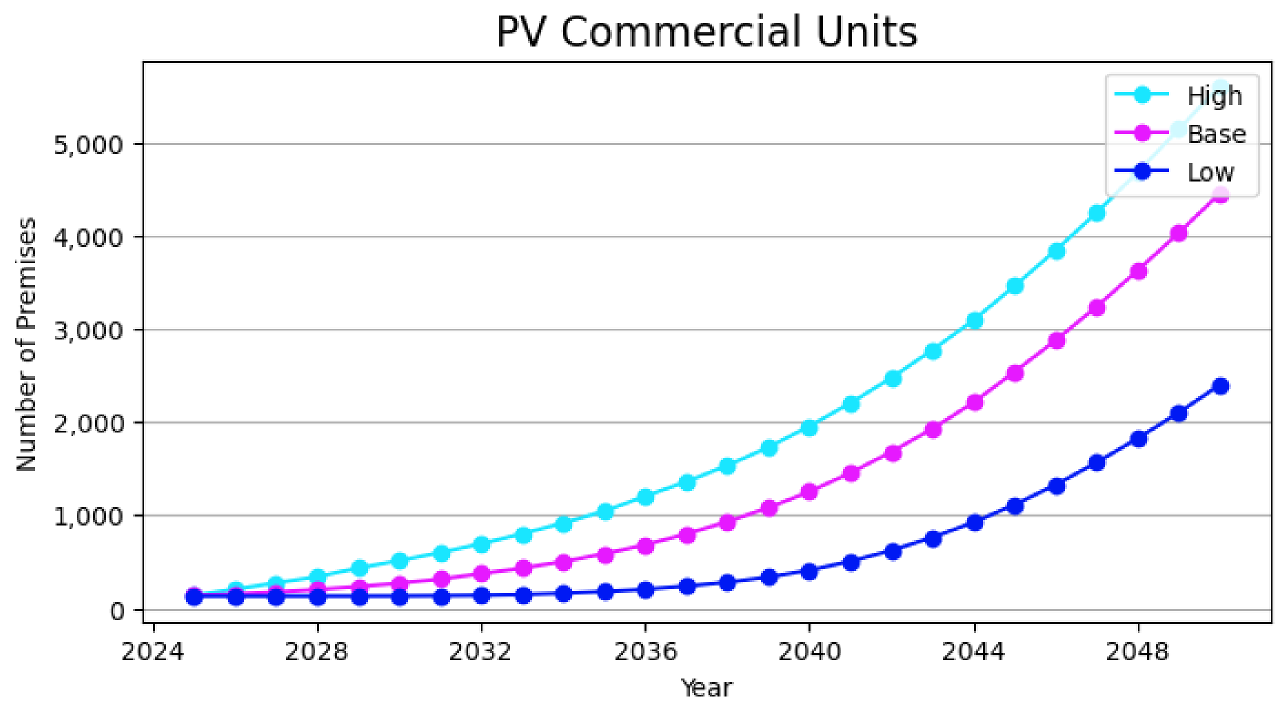
18k~80k



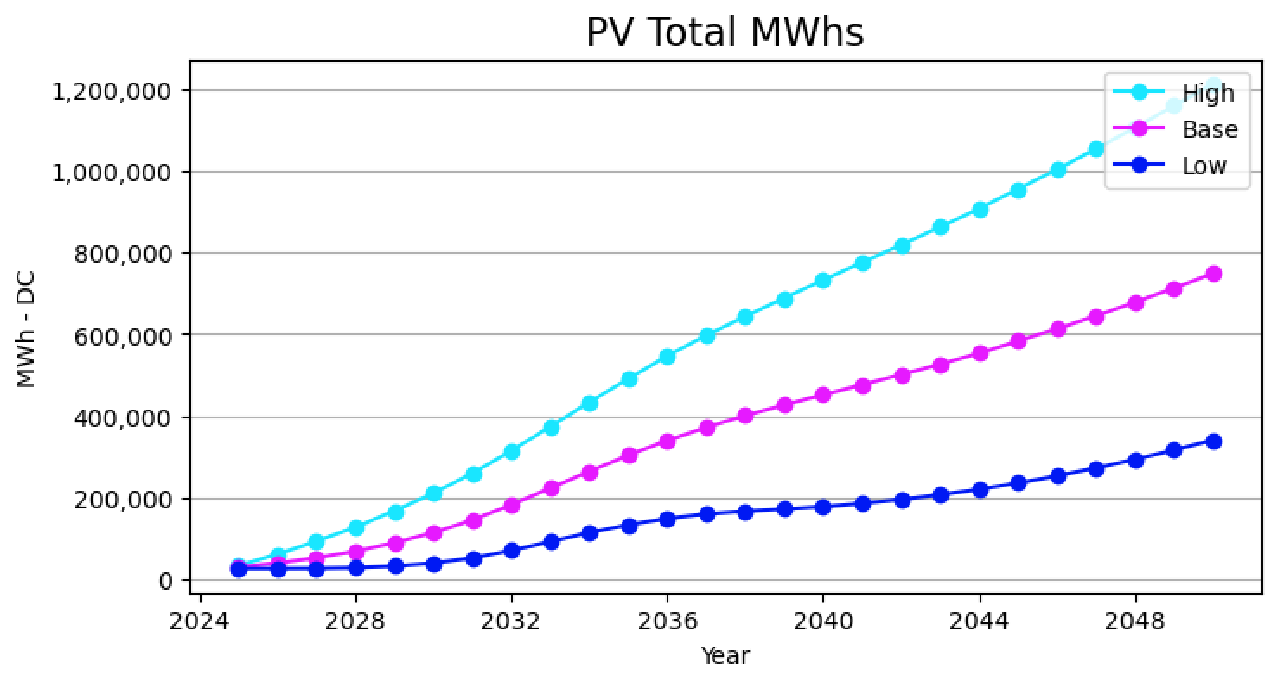
15k~75k



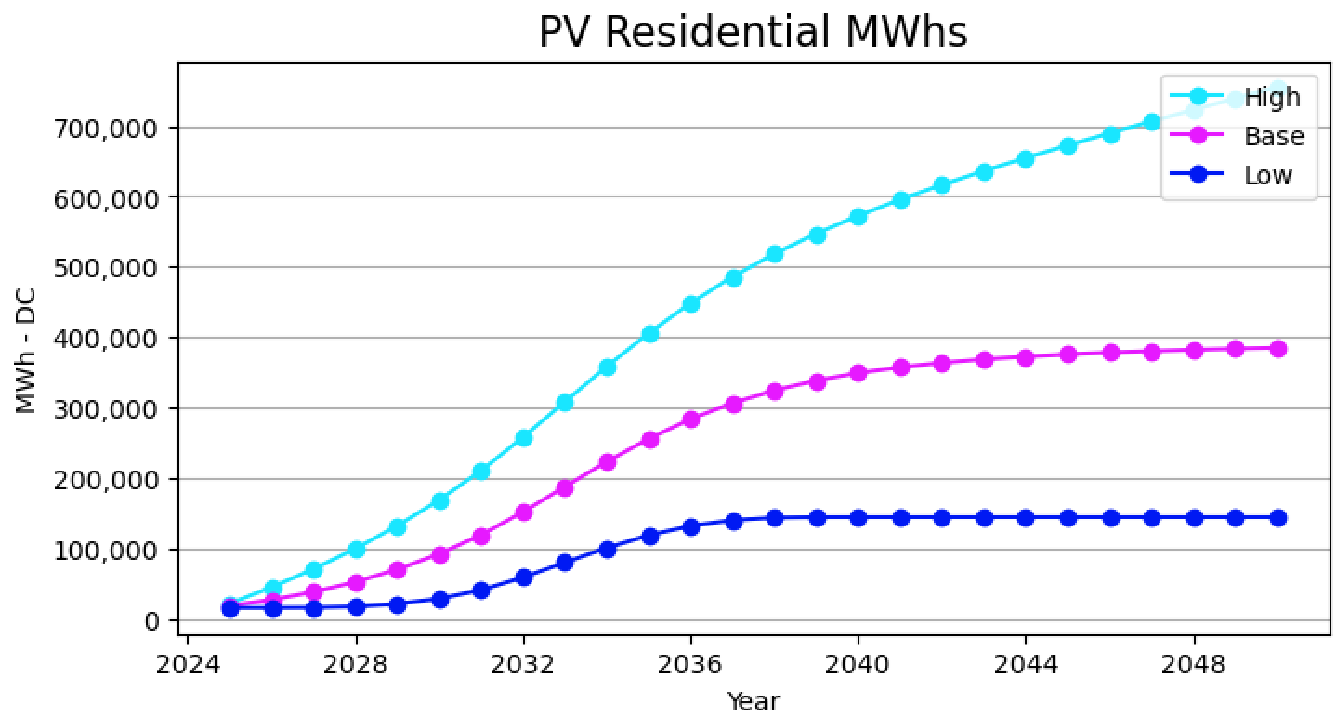
2k~5k



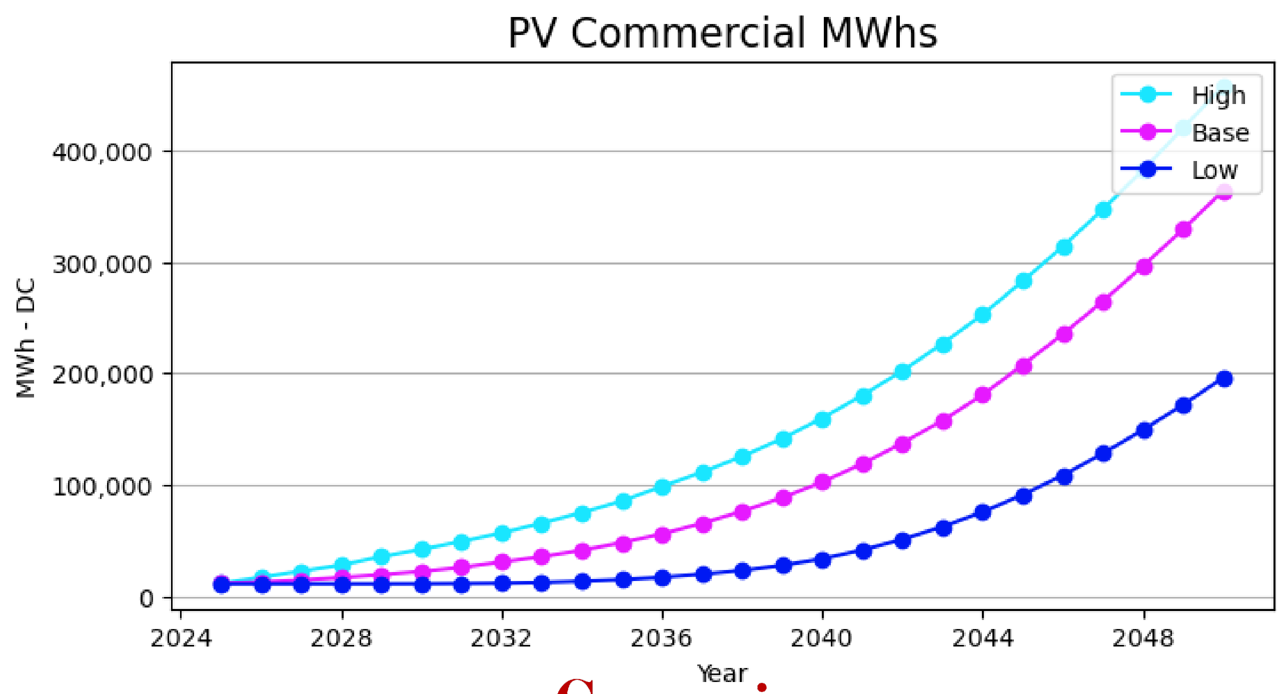
0.3M~1.2M



0.15M~0.75M

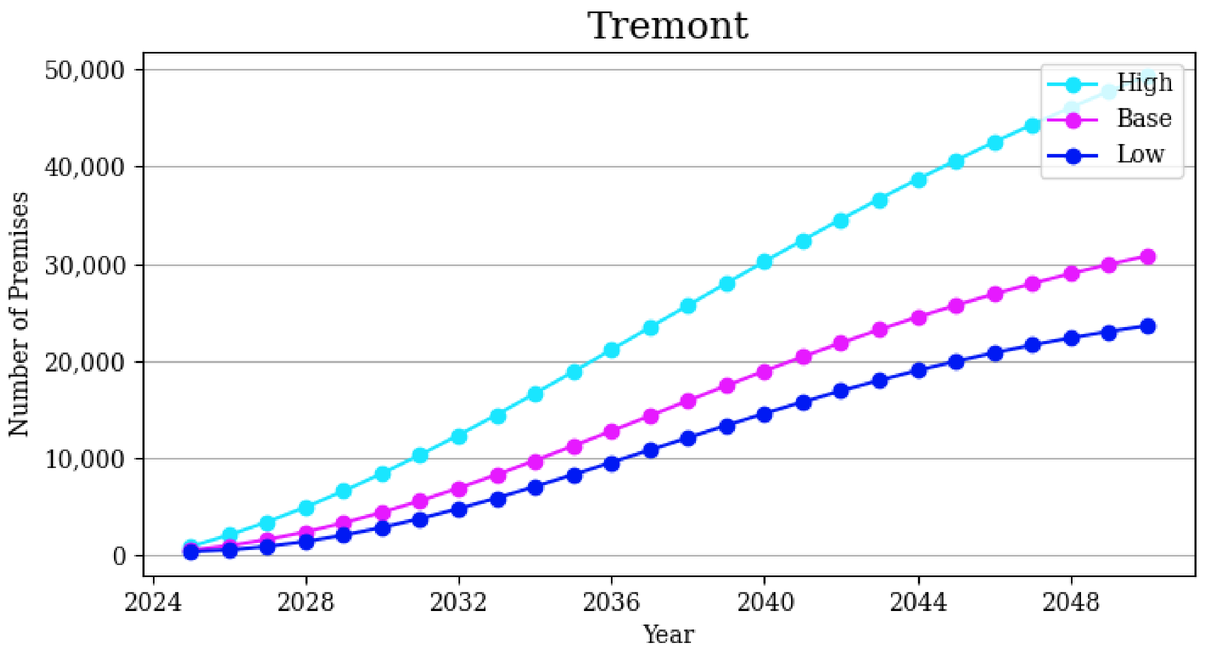


0.2M~0.45M



Result: Sub-station EV Prediction

Final predictions and their uncertainty vary significantly across substations



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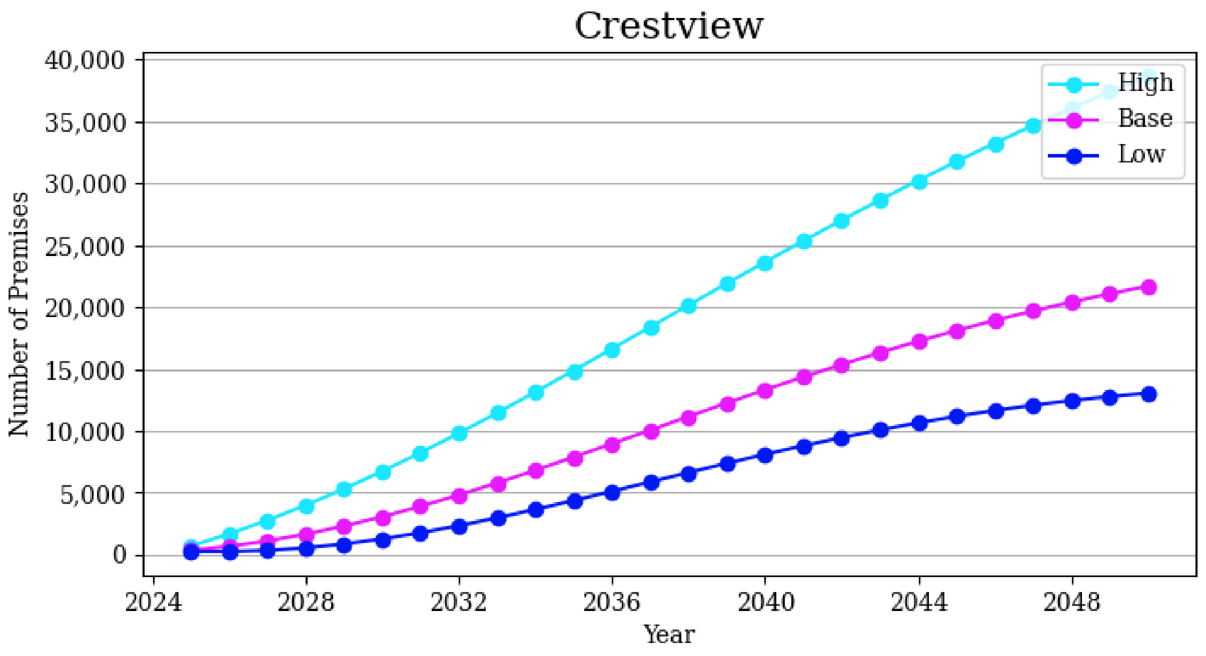
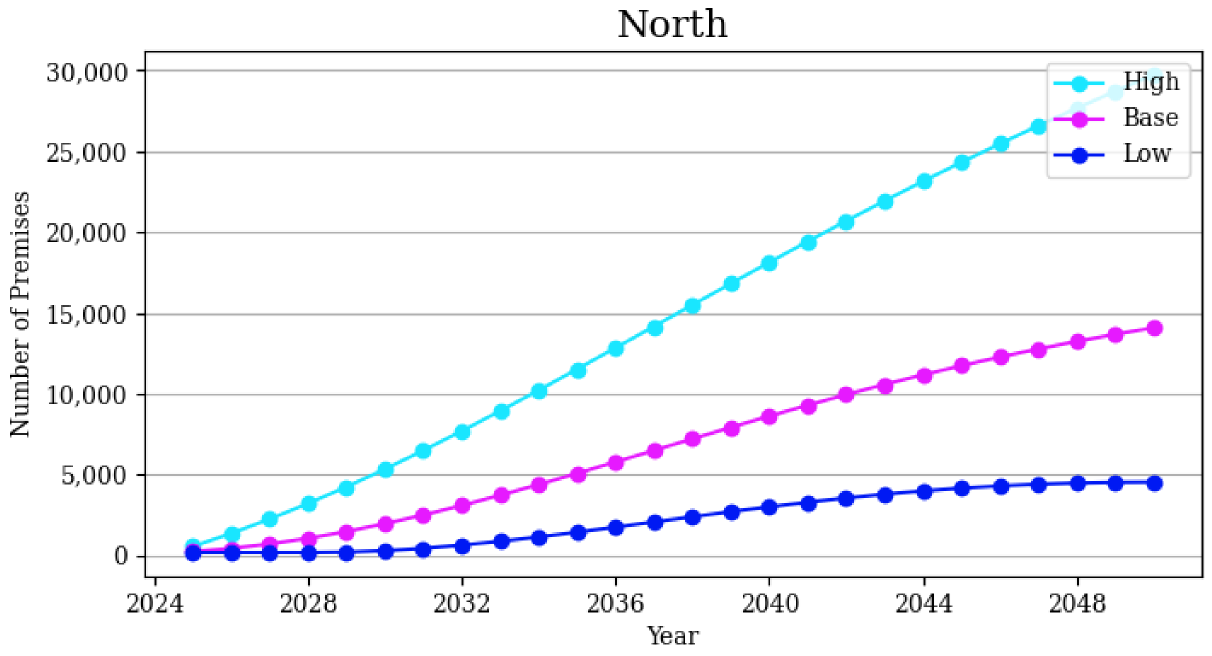
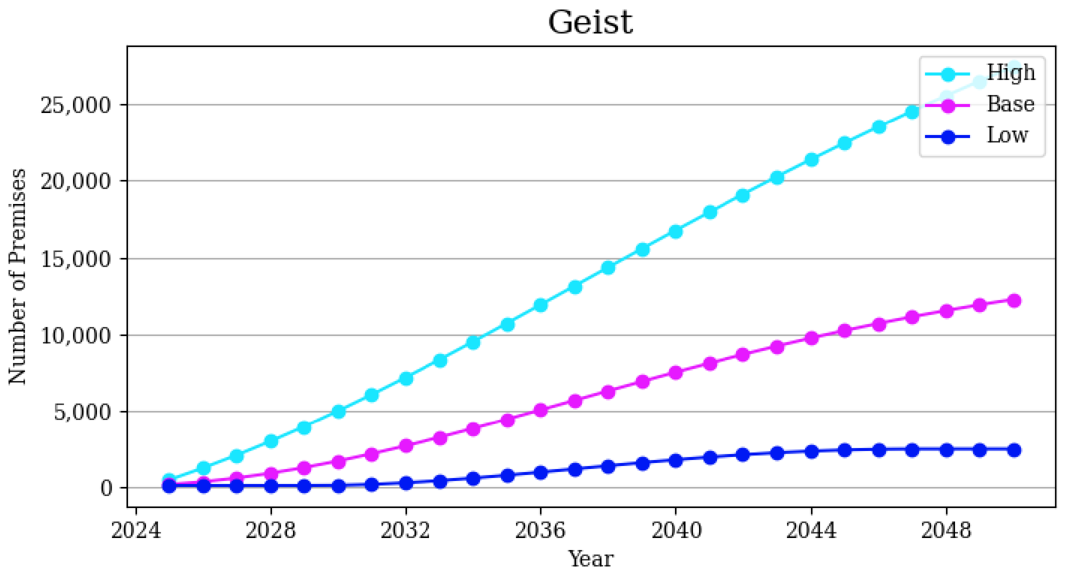


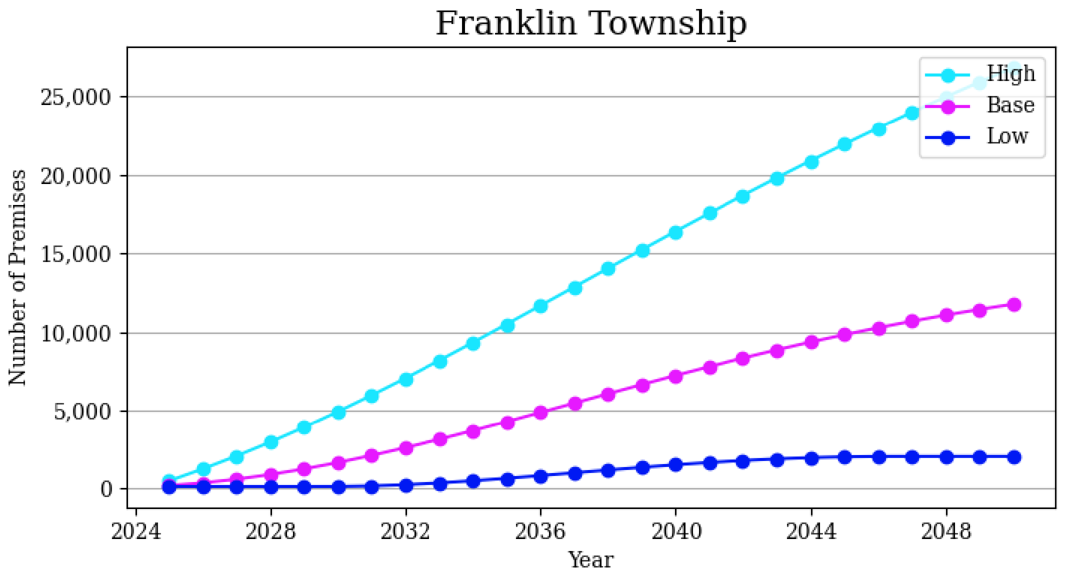
Top 2



Top 3



Top 4



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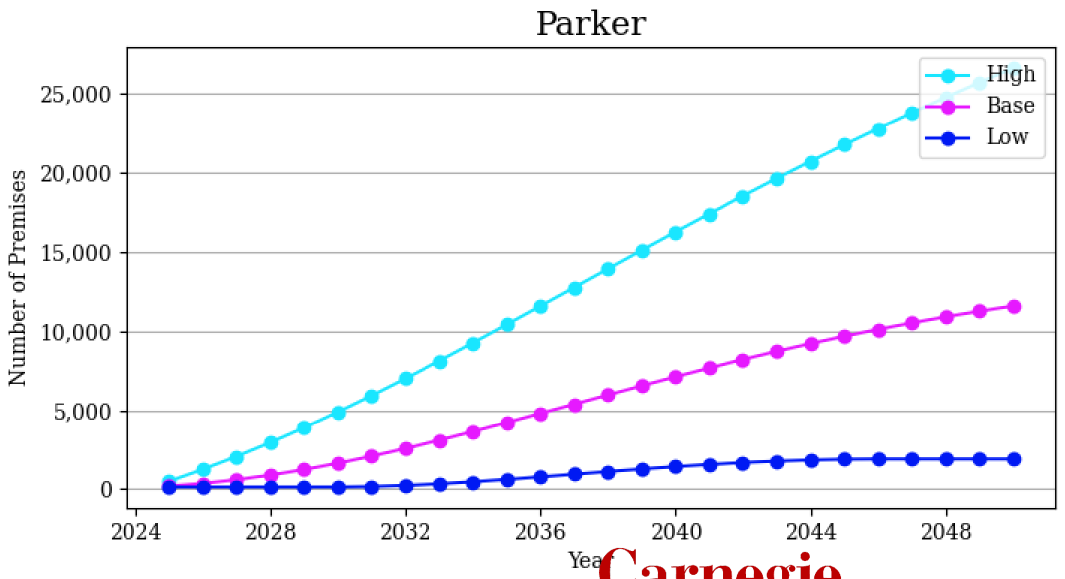
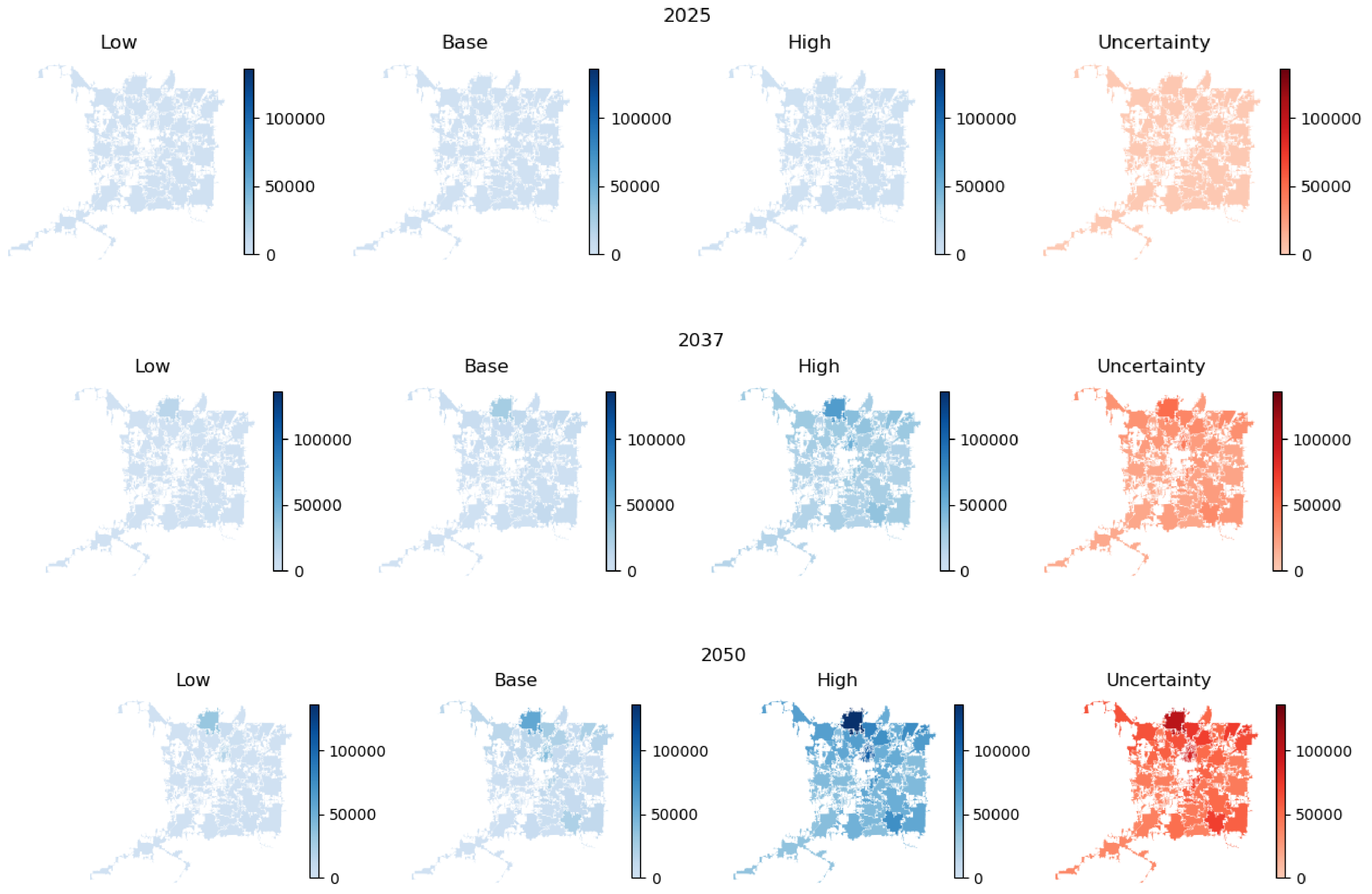


Top 6

Result: Sub-station EV Prediction

EV Total Units

EV Total Load



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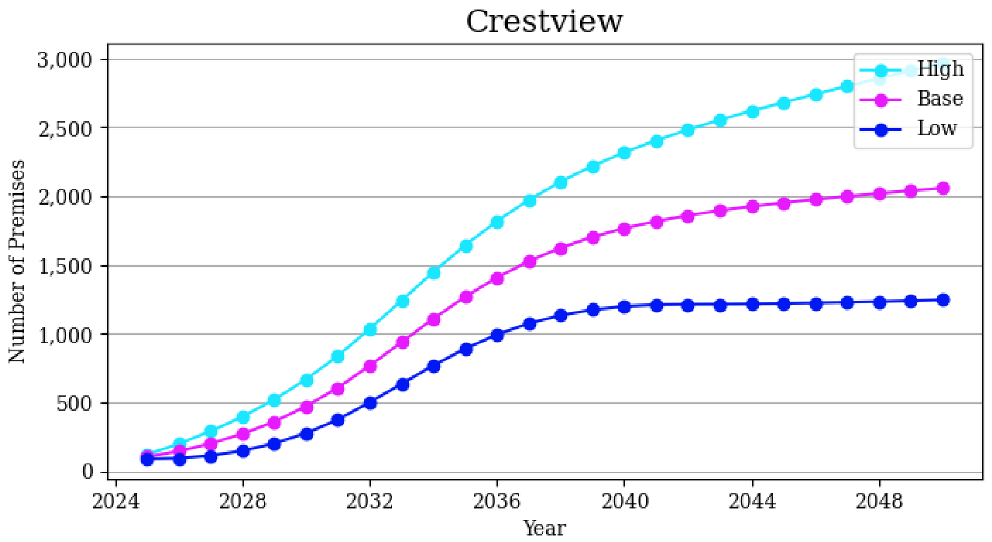
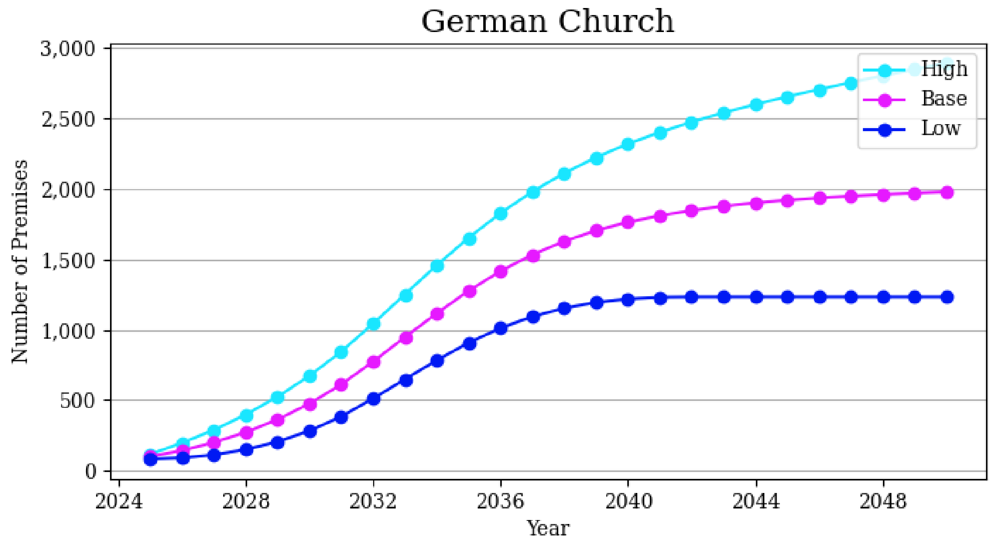
Result: Sub-station PV Prediction

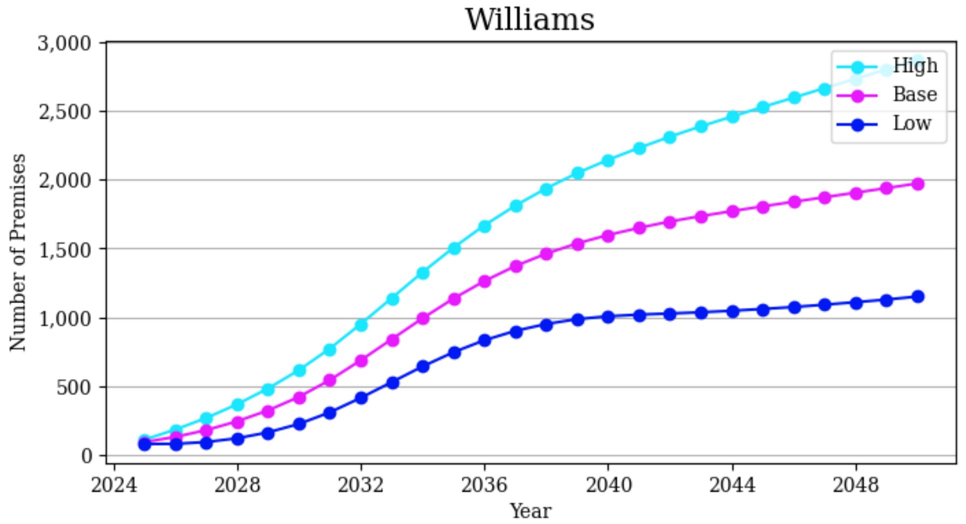
Final predictions and their uncertainty vary significantly across substations



Top 1



Top 2



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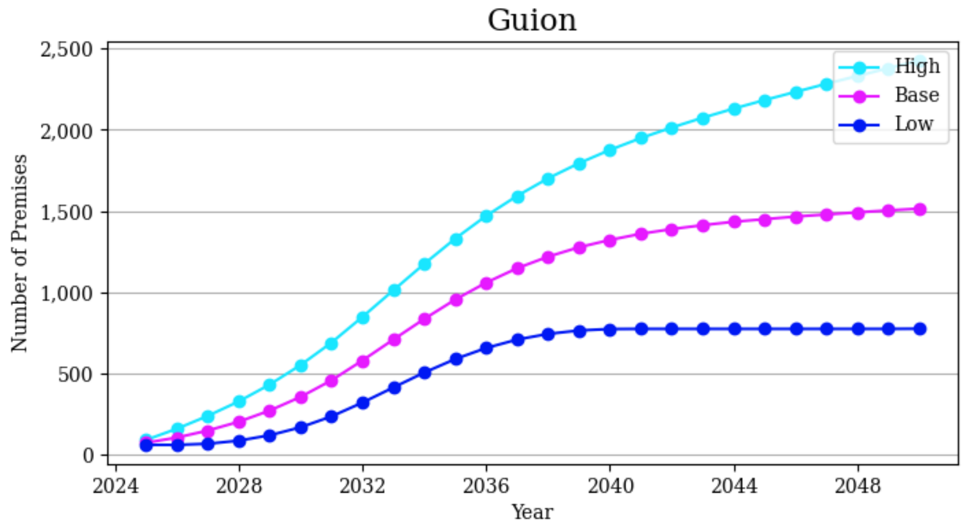

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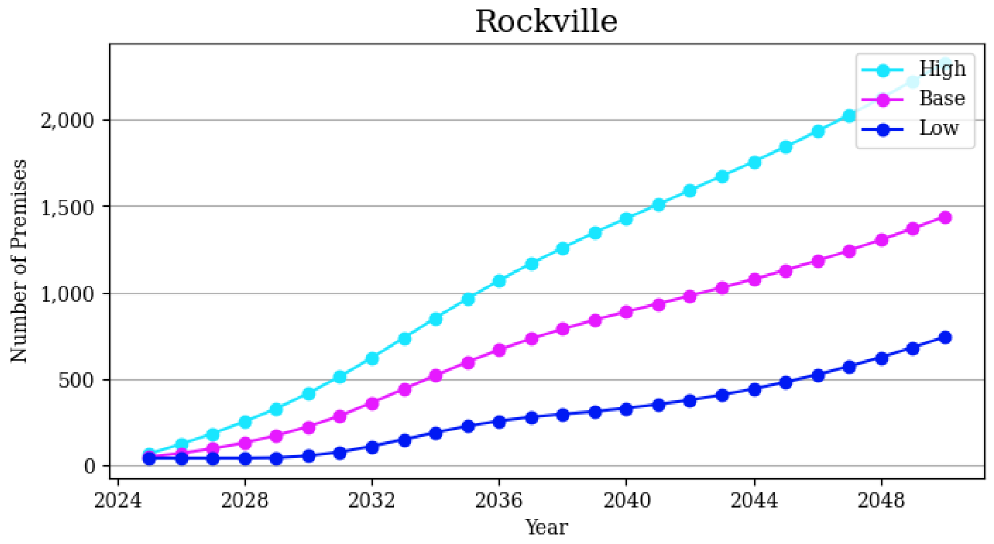

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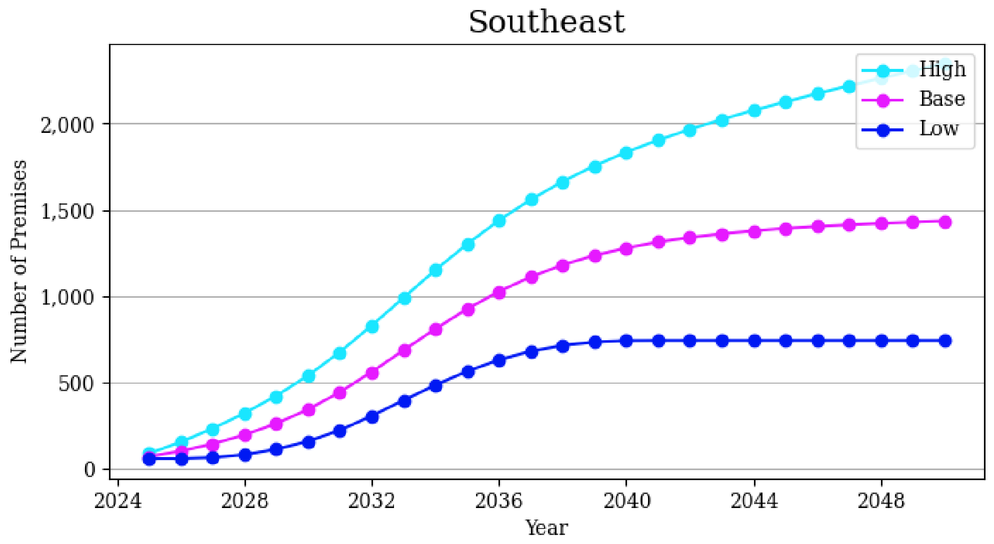

Top 6

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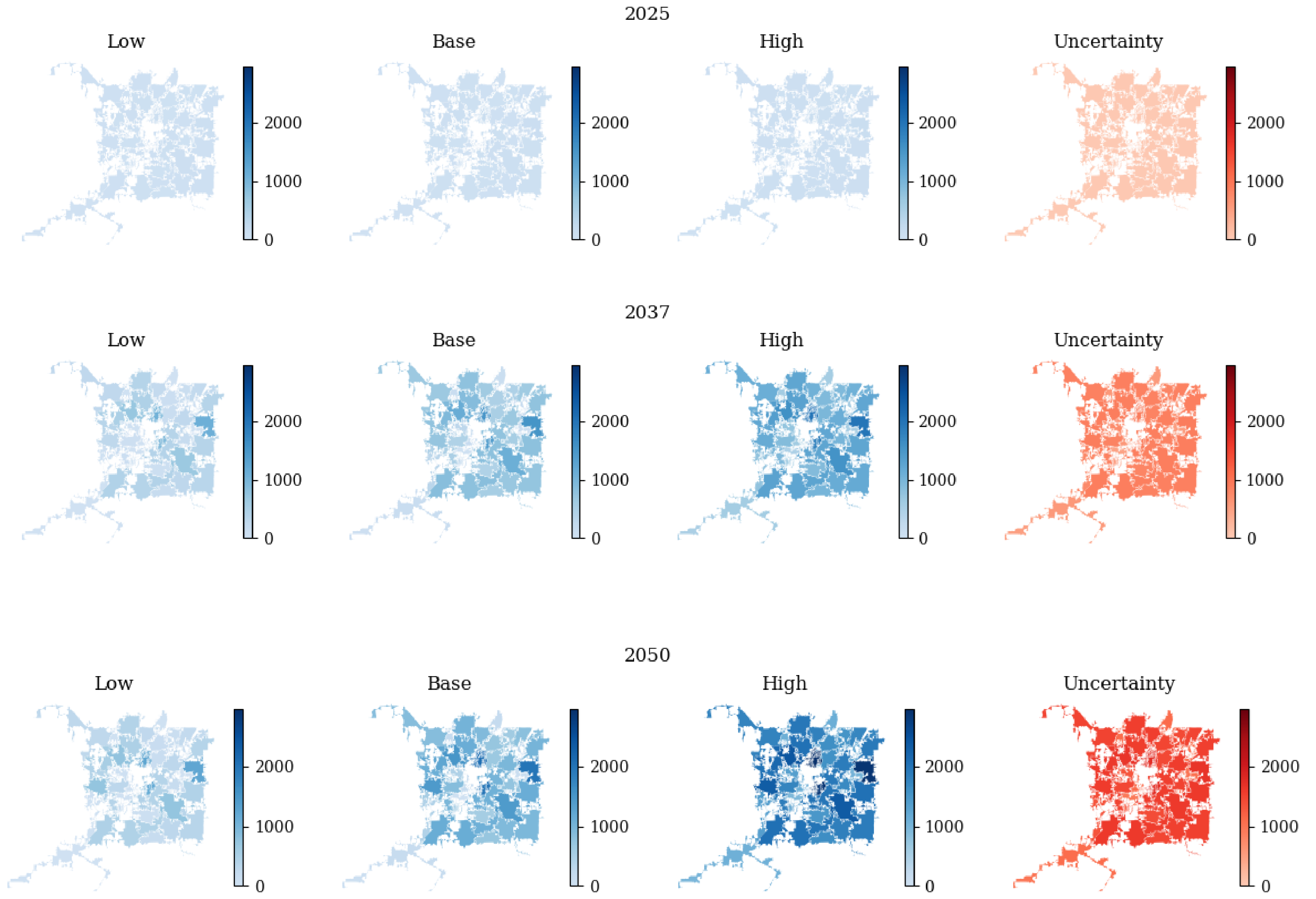
Result: Sub-station PV Prediction

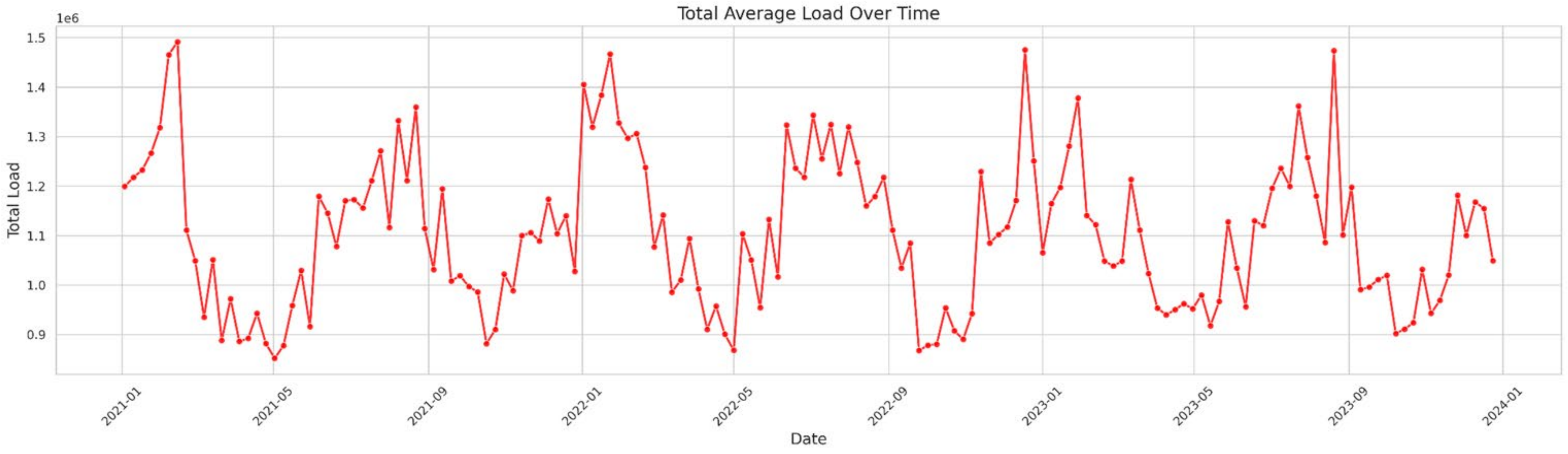
PV Total Units

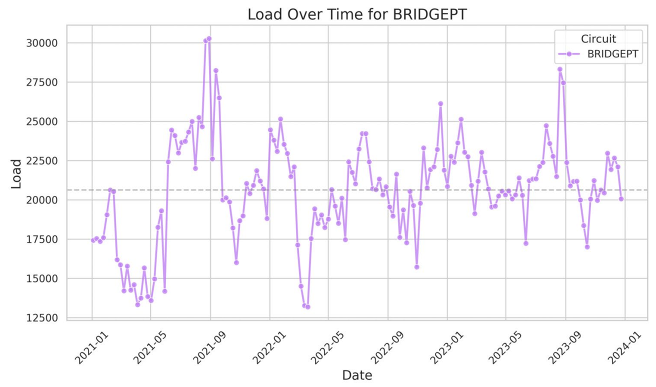


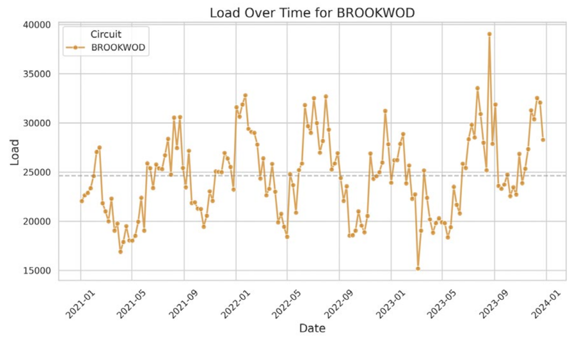
PV Total Generation

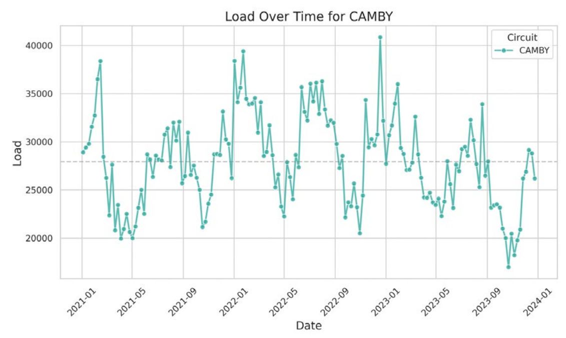
Appendix: Load Data

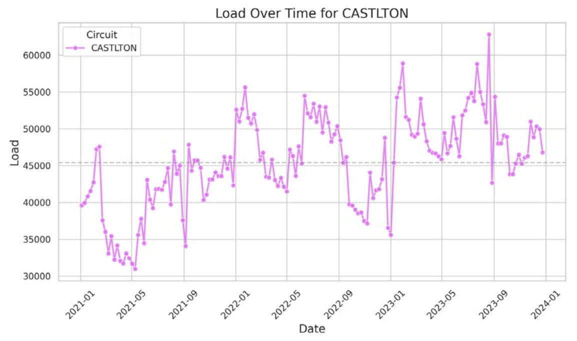
Avg



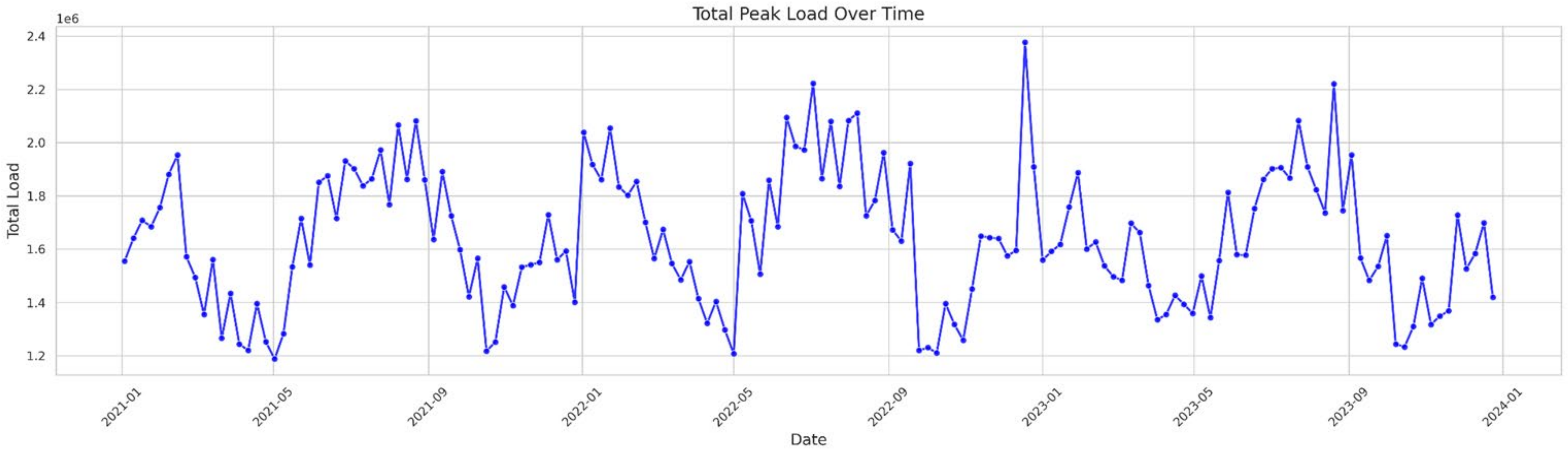


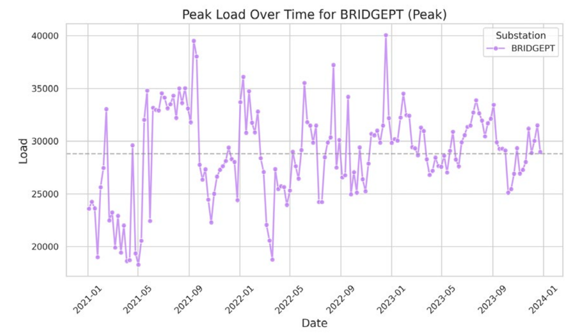


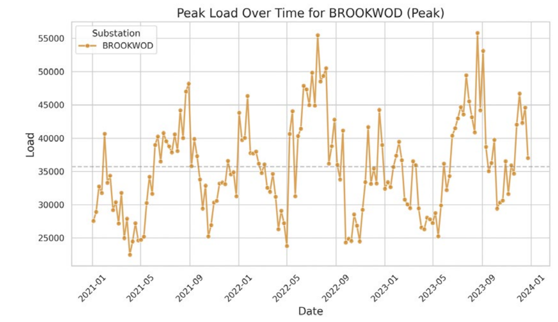


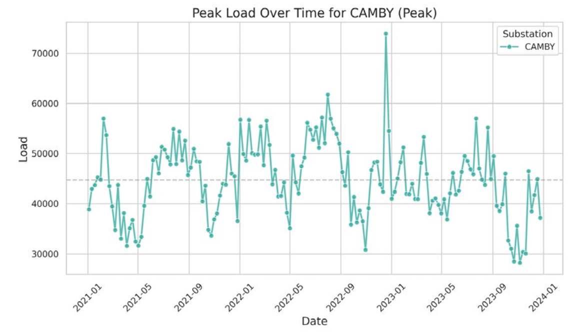


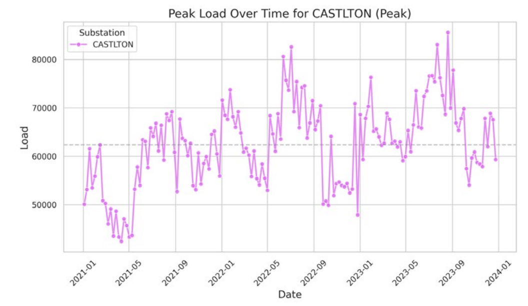
Peak







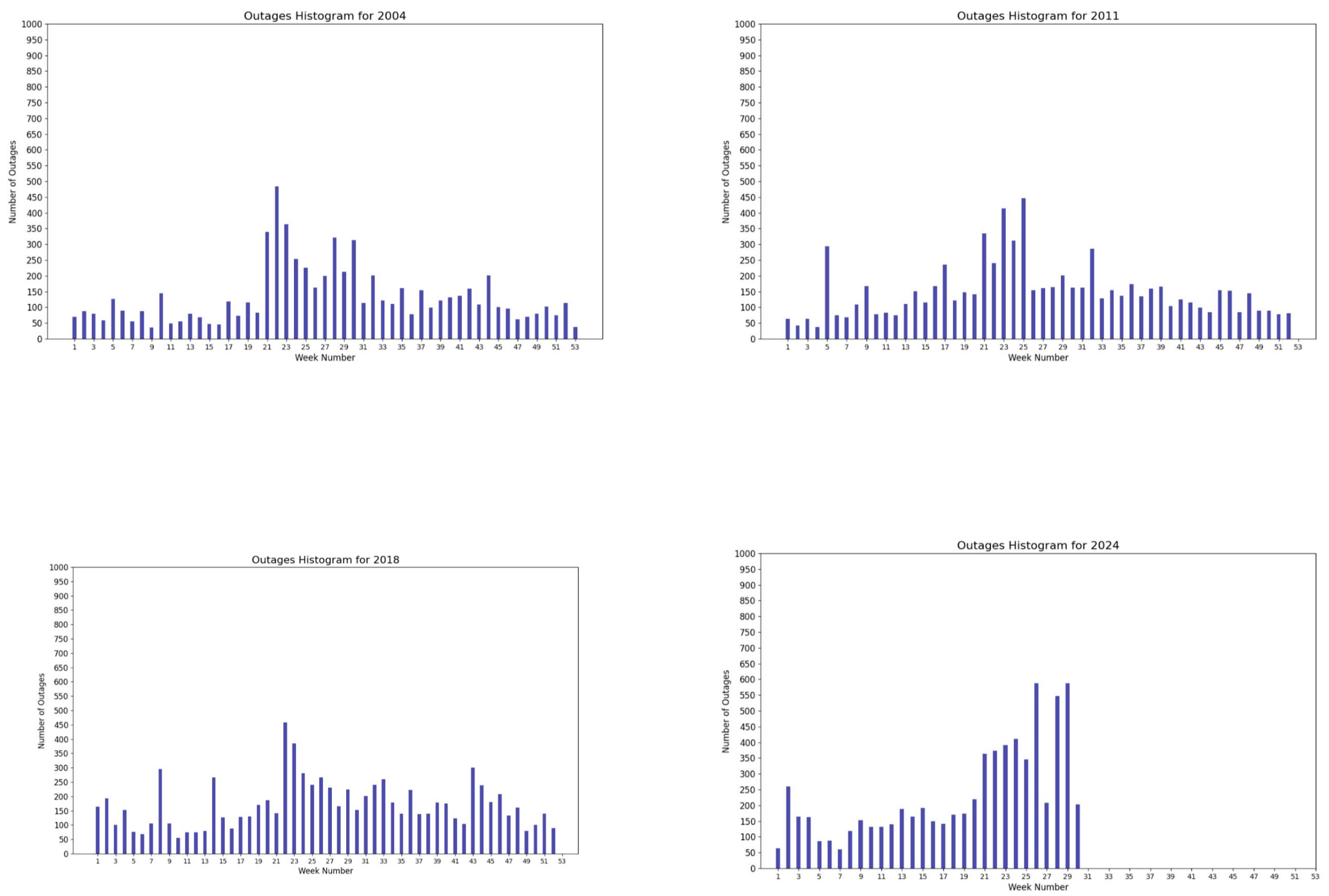




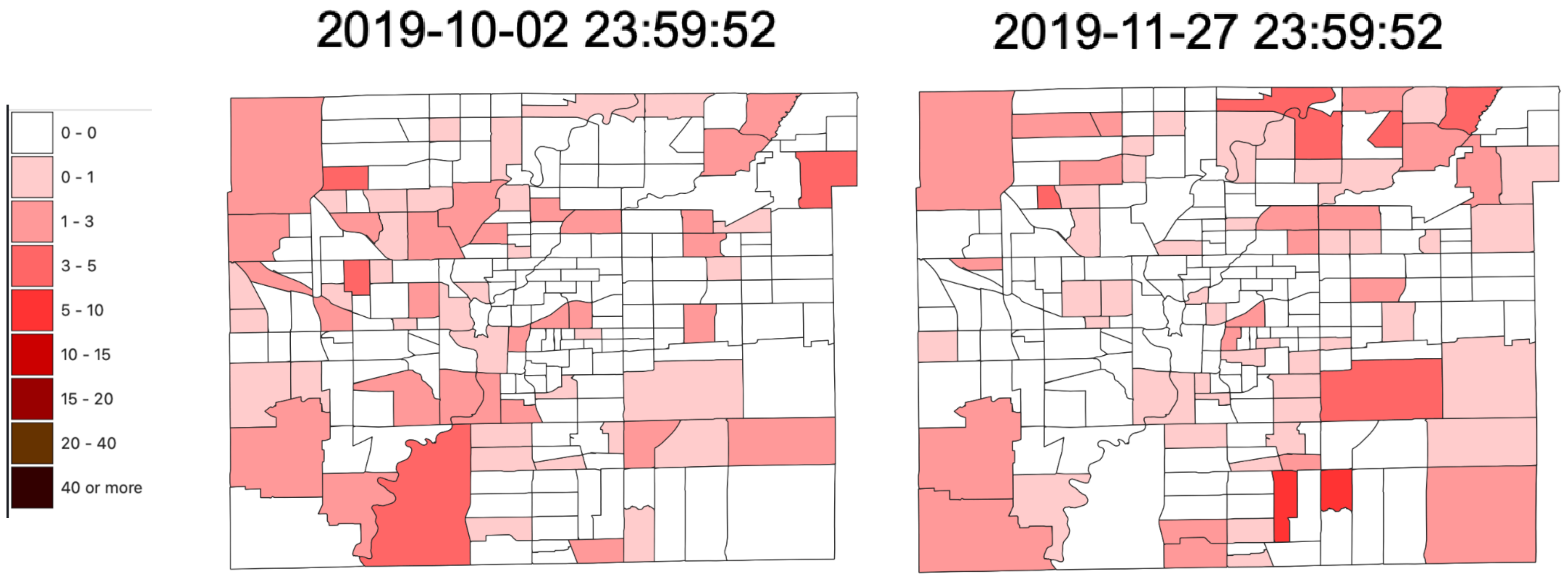
Total

Substation-Level

Appendix: Outage Data

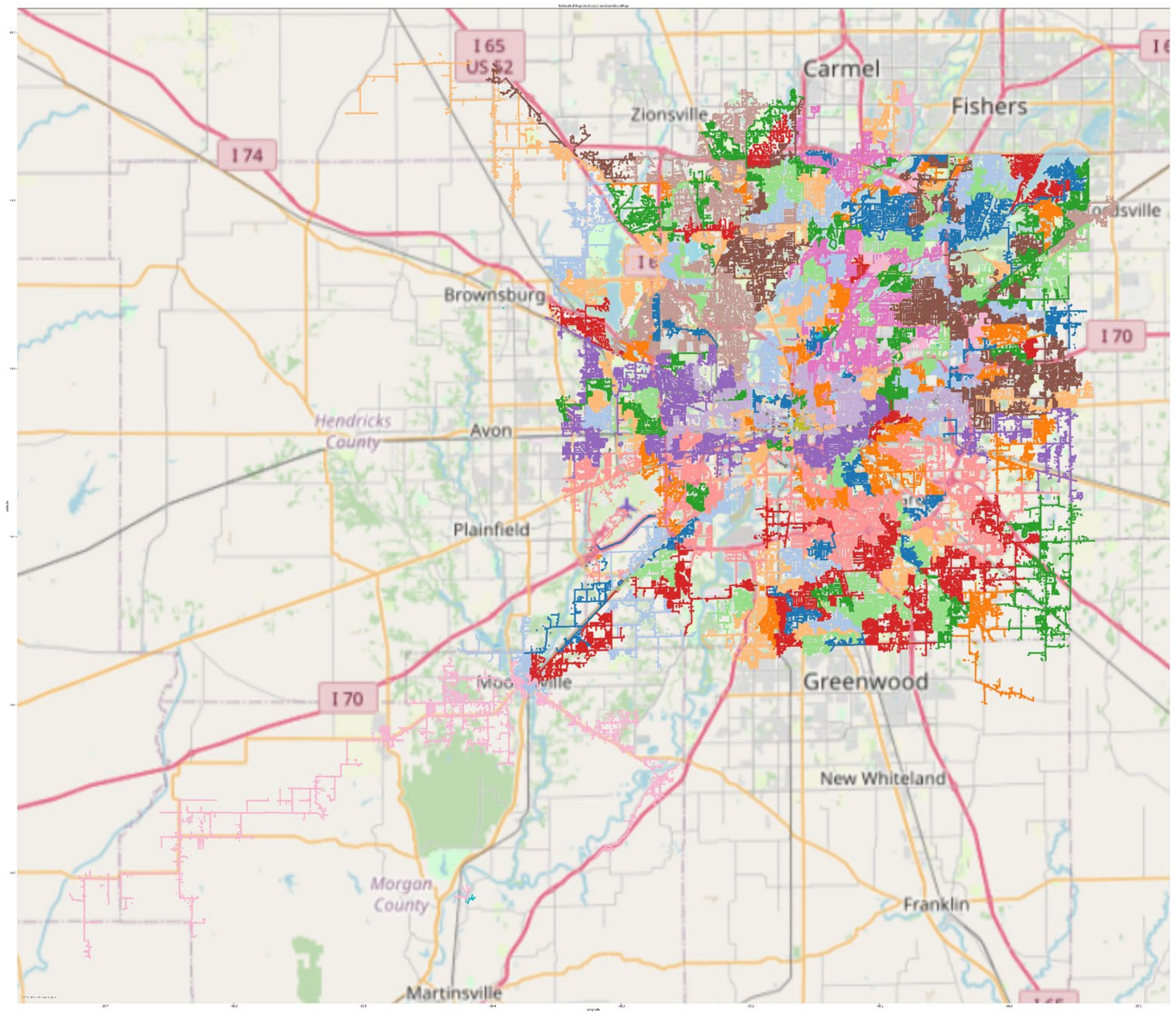


Temporal View



Spatial View

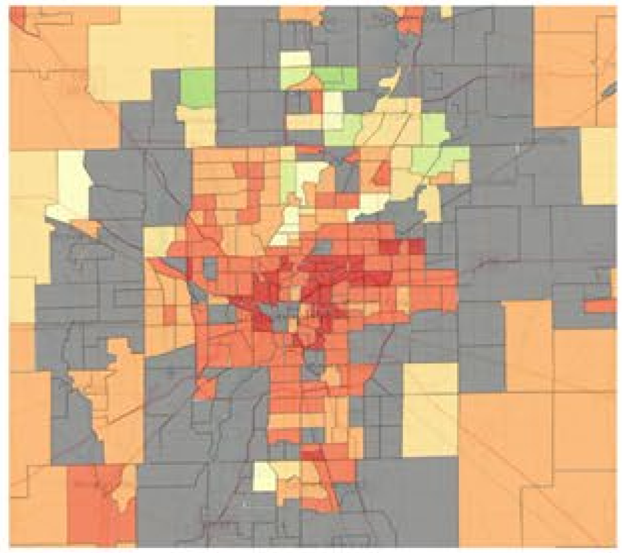
Appendix: Transmission Topology



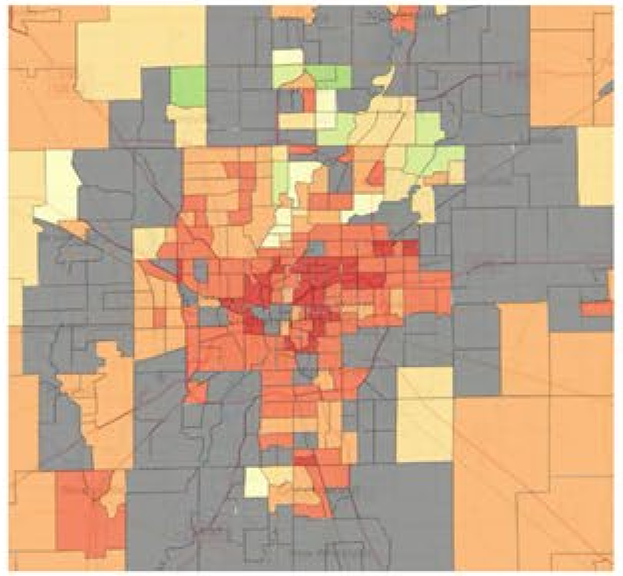
Match data from multiple sources to each household

Appendix: Demographic Factors

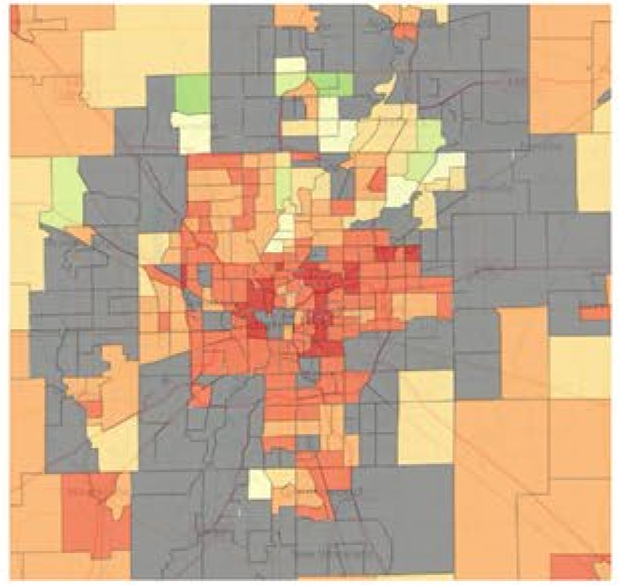
e.g., Household Income



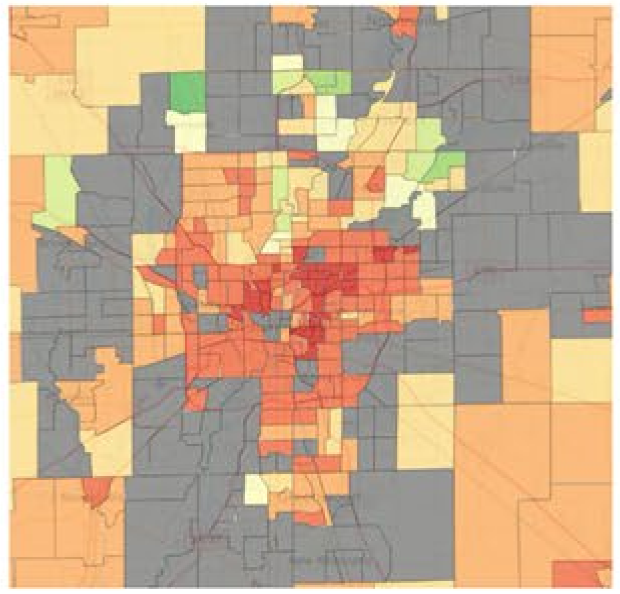
2015



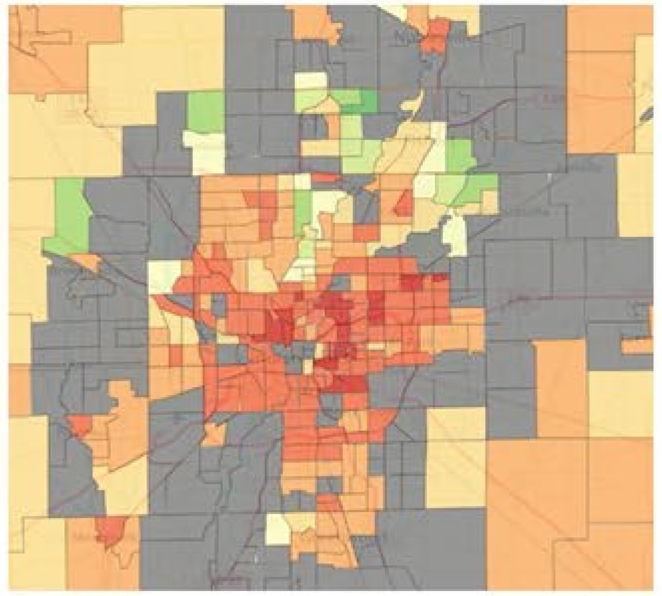
2016



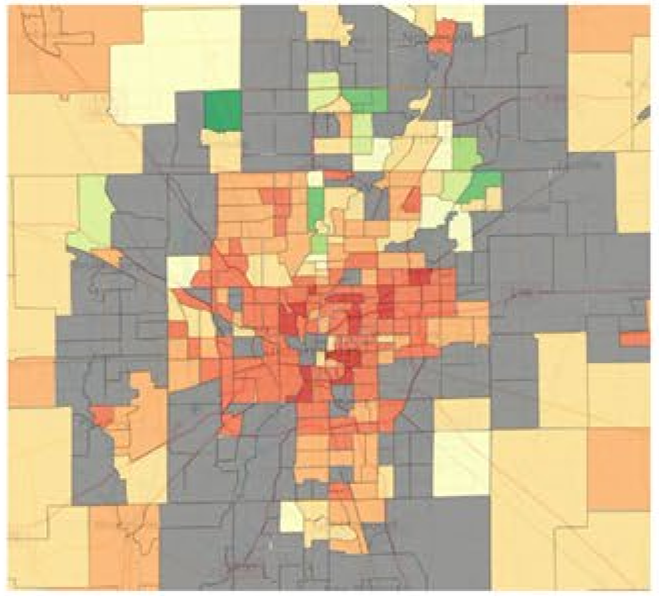
2017



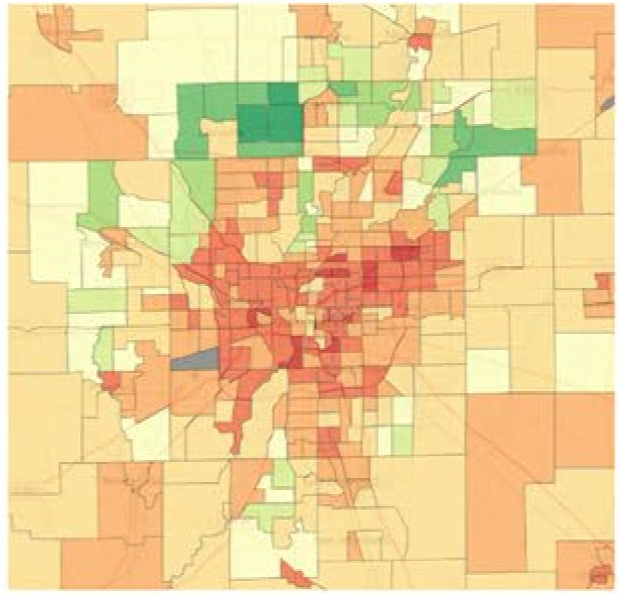
2018



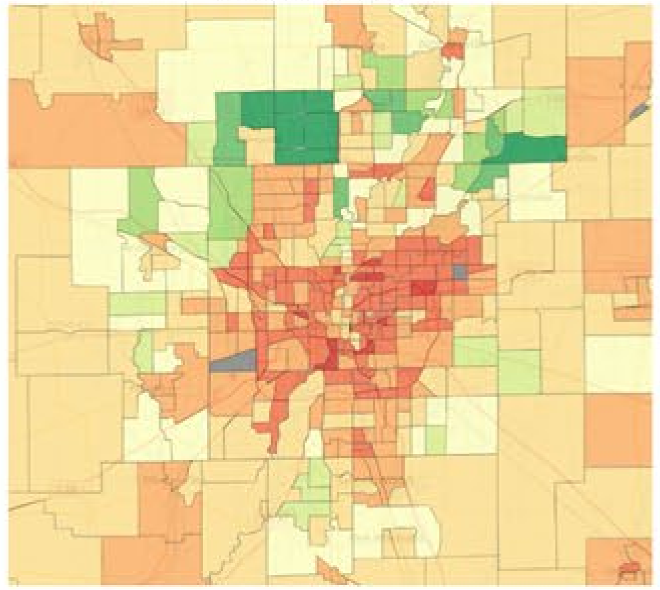
2018



2019



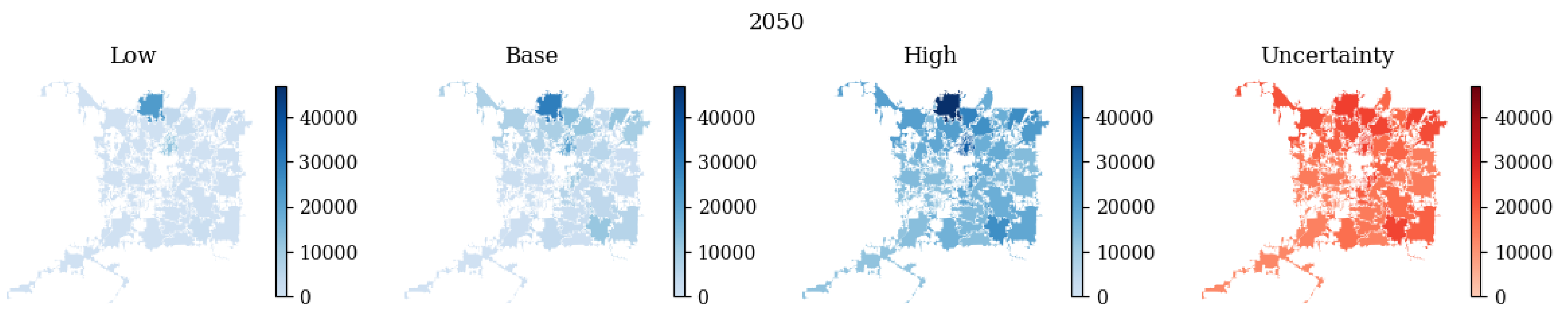
2020



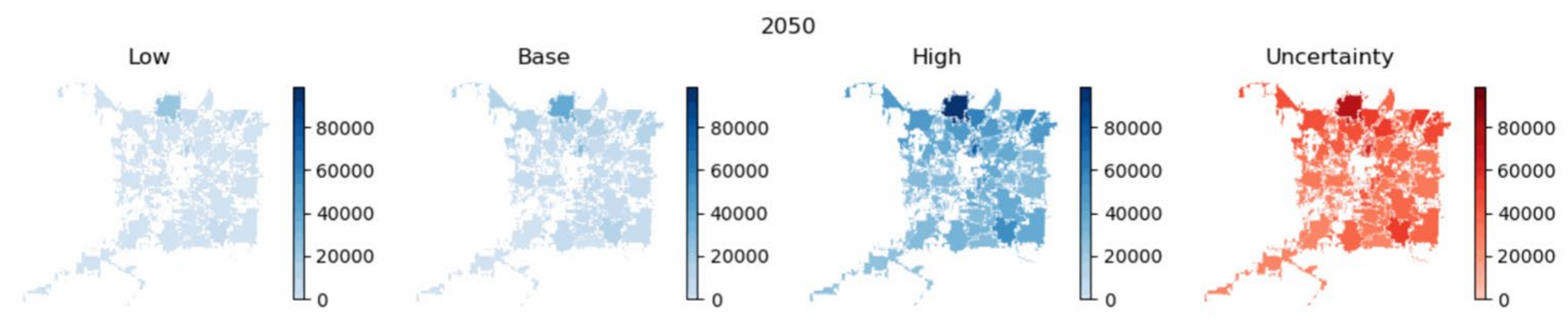
2021

Appendix: More Results

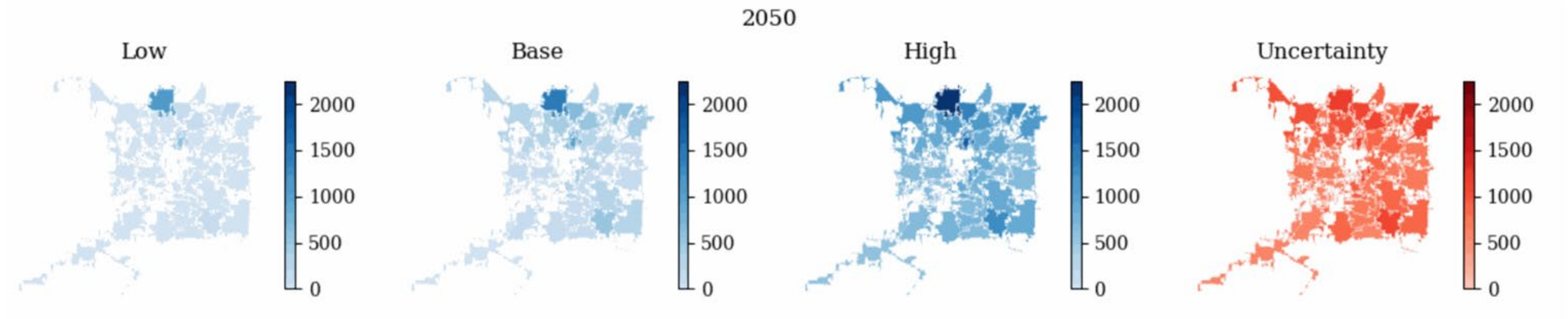
EV Residential Units



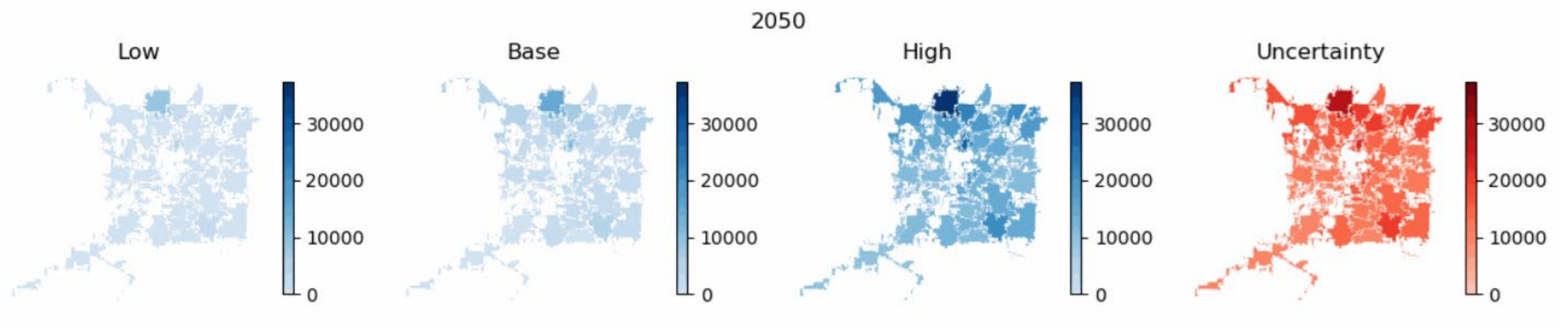
EV Residential Load



EV Commercial Units

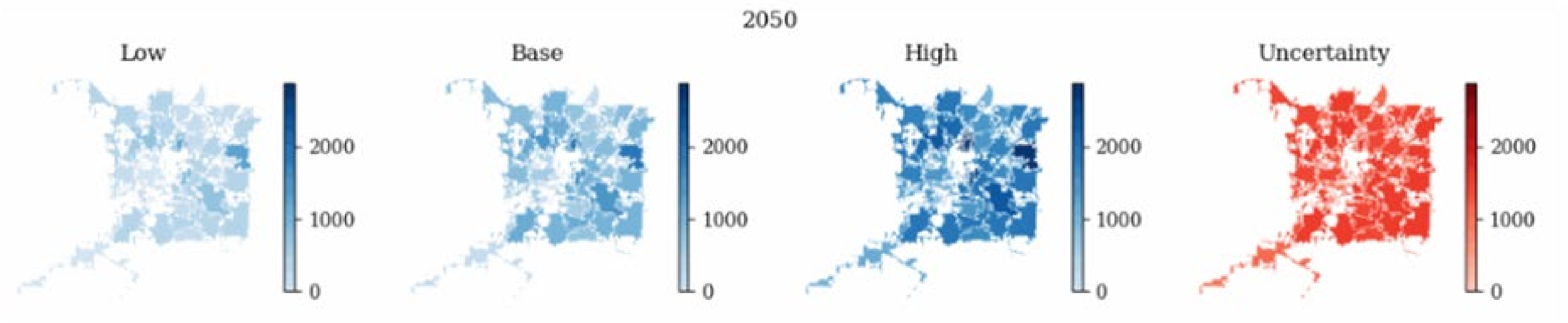


EV Commercial Load

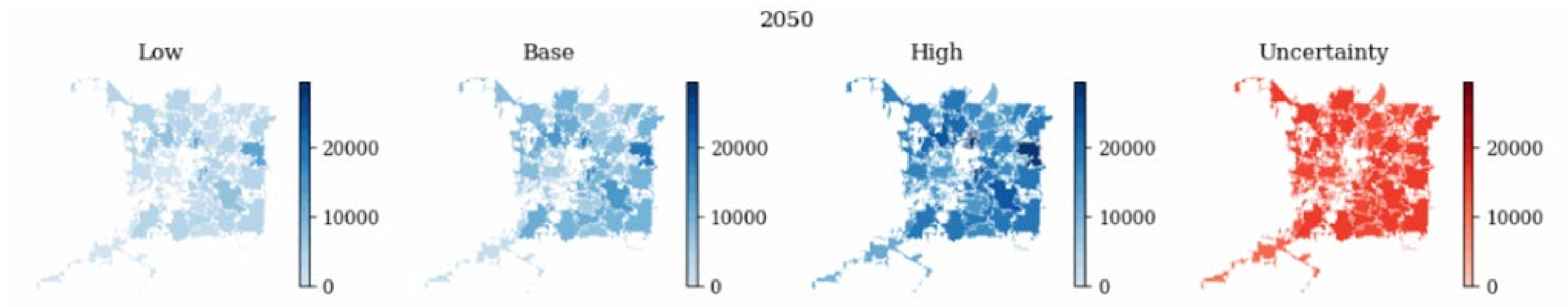


Appendix: More Results

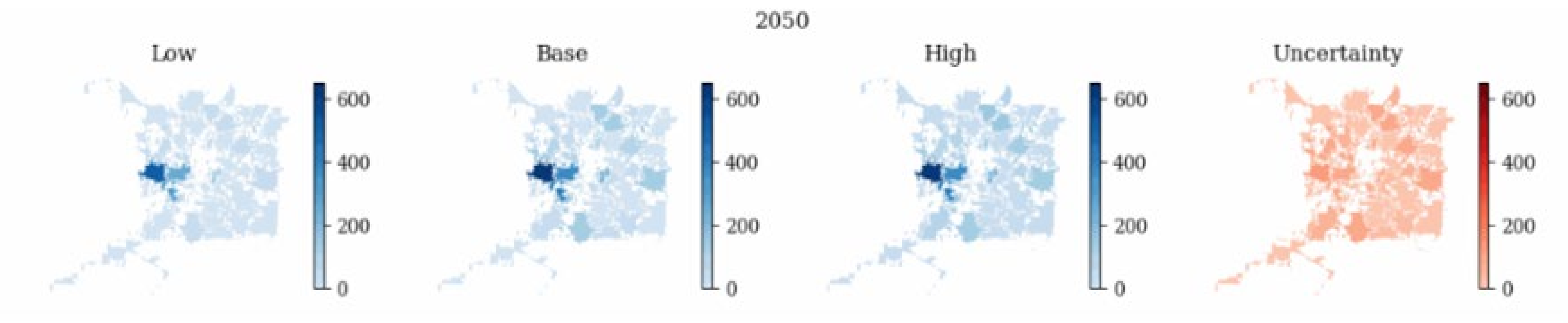
PV Residential Units



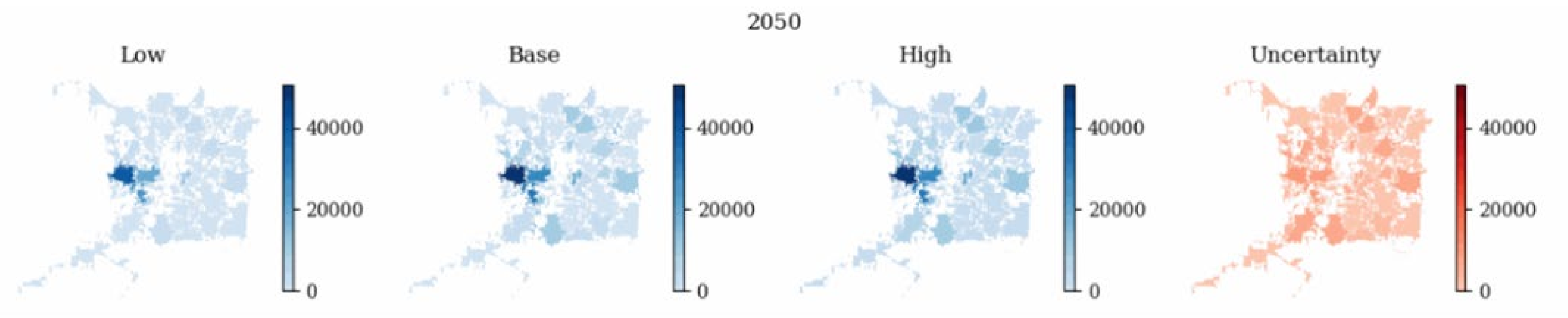
PV Residential Generation



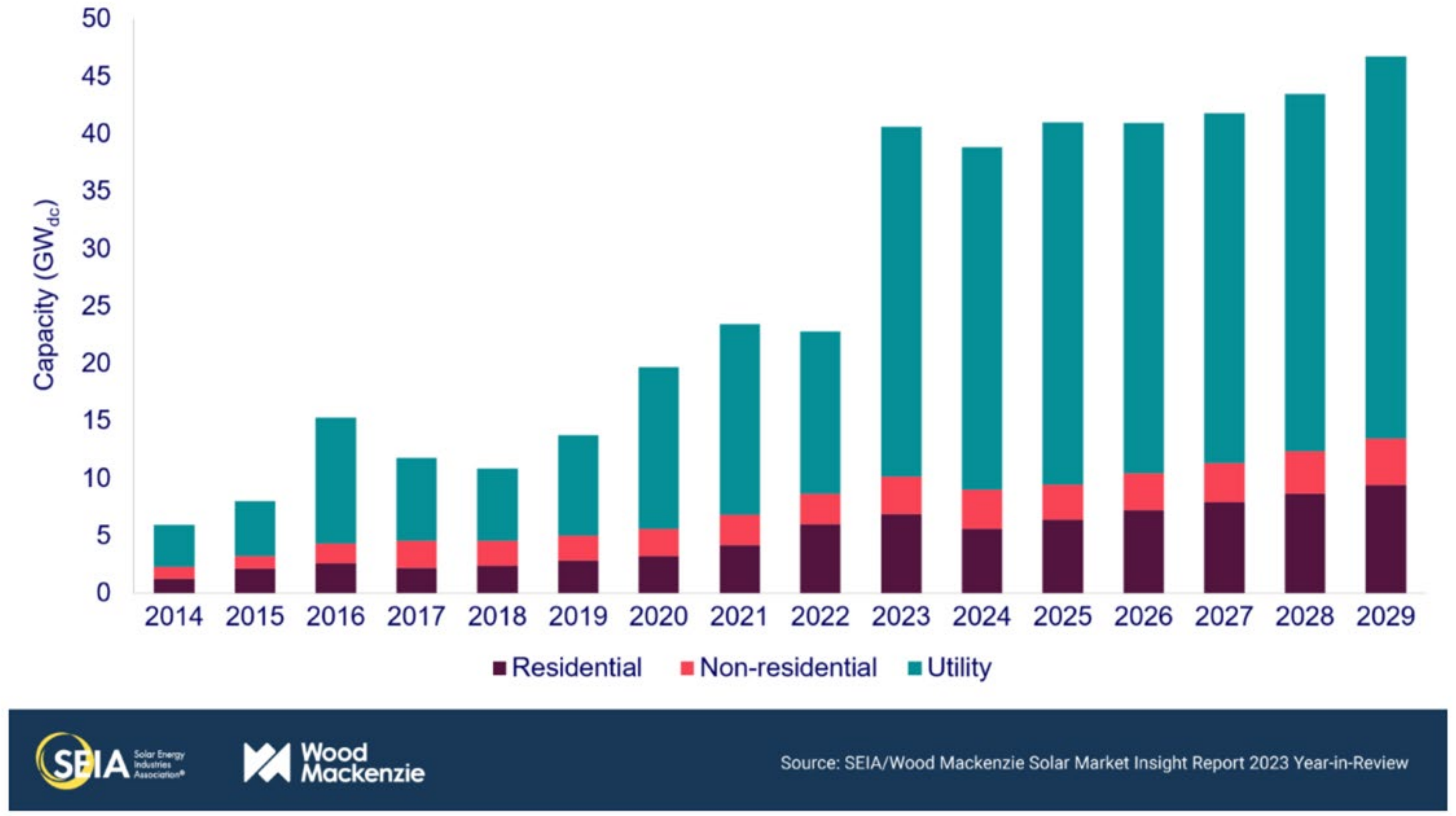
PV Commercial Units



PV Commercial Generation



Appendix: Facts about PV installations



US PV Installation and forecasts by sectors, 2014 - 2029 (by Solar Energy Industries Association)

U.S. Adoption Rate Table

State	Total # of Houses[A]	Total # of Solar Installed	Total % of Solar Installed
California	14,392,140	1,183,653	8.2%
Florida	9,865,350	~ 99,530	1.0%
Hawaii	561,066	86,866[x]	15.5%
Massachusetts	2,998,537	~ 118,273	3.9%
New York	8,488,066	112,424[x]	1.3%
Texas	11,589,324	~ 125,003	1.1%

Sources: U.S. Census Bureau; California Distributed Generation Statistics ; Solar Energy Industries Association, Hawaiian Electric, New York State Projects

US PV adoption rate, where California has approximately 8.2% penetration rate.

Appendix: Details on Tipping Point

→ **Definition:** Date when the **5% EV adoption** mark is hit.

→ This is equivalent to the time when EV demand reach fastest growth, as defined in our model.

→ Camus Energy gave an estimation based on their feeder-level EV projection trajectory as part of their study analyzing investment optimization for AES.

→ **Source:** National Renewable Energy Laboratory's (NREL) Demand-Side Grid (dsgrid) TEMPO Light-Duty Vehicle Charging Profiles, U.S Energy Information Administration's Annual Energy Outlook.

→ **Result:** the mark occurs in 2029.

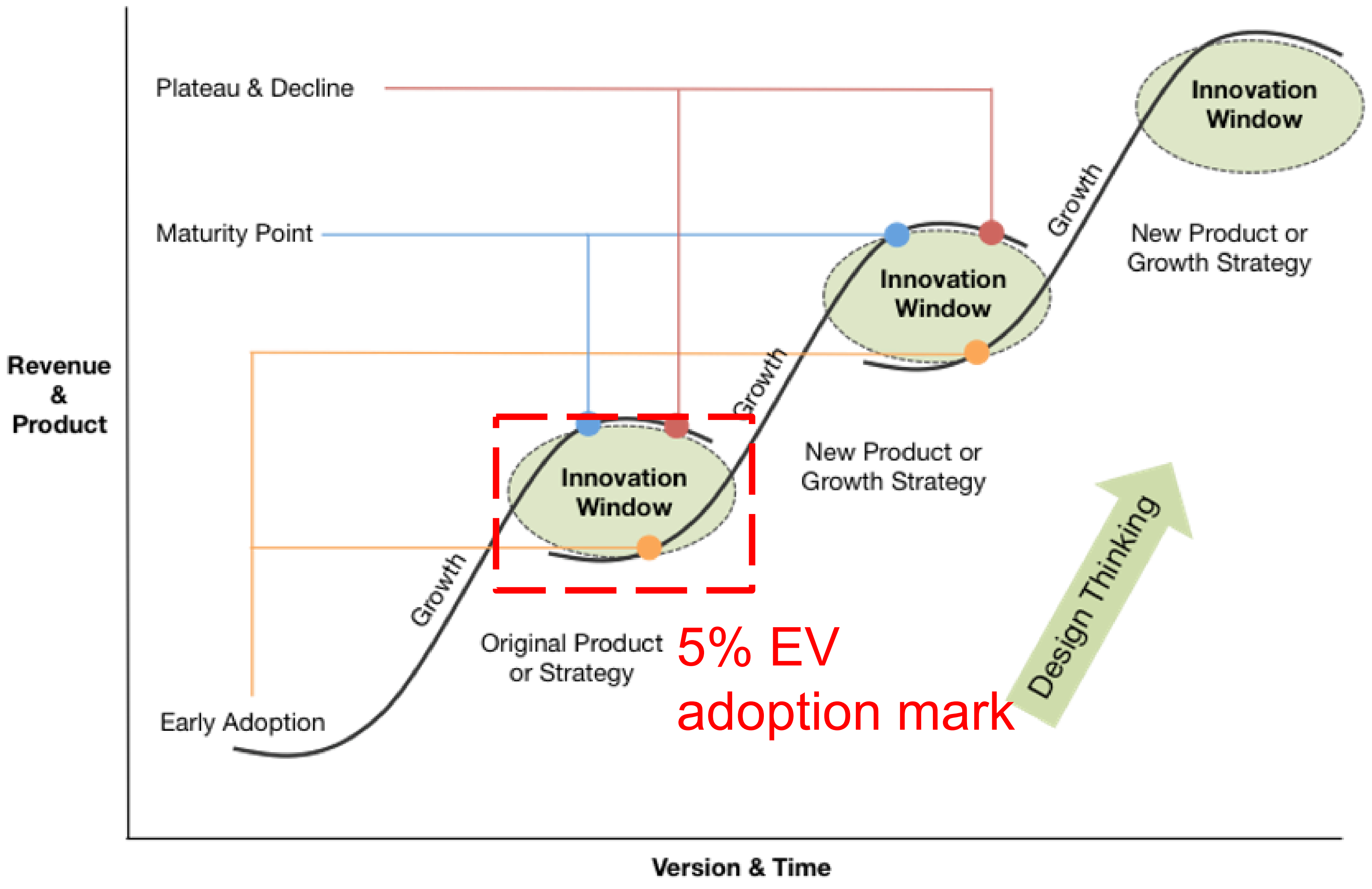


Figure: Diagram showing the theoretical evolution growth trend of EV adoption.

Appendix: Details on Tipping Point (Cont.)

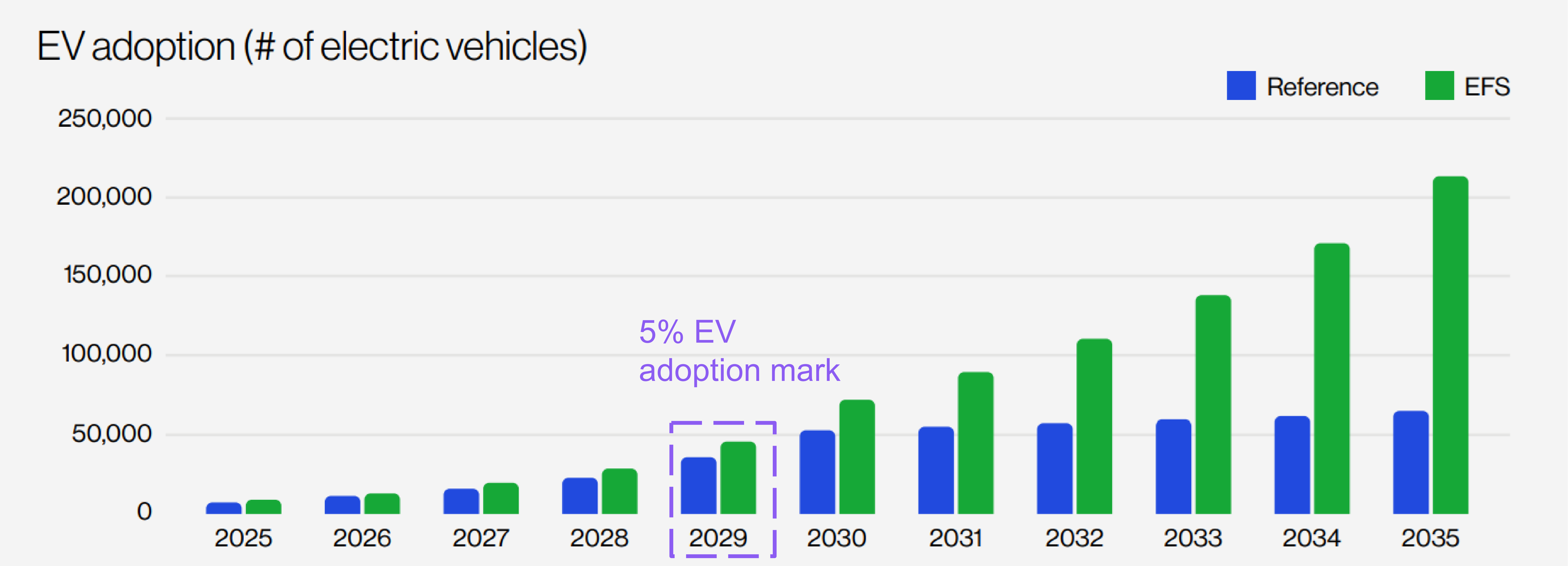


Fig 4. Residential EV adoption for AES Indiana service territory by case. Reference (blue) refers to the Energy Information Administration's Annual Energy Outlook. EFS (green) refers to NREL's Electrification Futures Study.

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