Nuclear Indiana Coalition

11/19/2025

Welcoming Remarks

Secretary Suzanne Jaworowski

11/19/2025

Governor Braun's "Moon Shot" Goal

11/19/2025

Indiana's Energy Landscape

INDIANA OFFICE OF ENERGY DEVELOPMENT

Luke Wilson, Chief Policy Officer

11/19/2025

OUTLINE

- Generation Planning & Transition
- Resource Adequacy
- Load Growth
- Nuclear Energy & Indiana

THE IURC's ROLE

- The IURC regulates the rates and charges of utilities under its jurisdiction.

- The IURC uses 'cost of service' ratemaking to determine the amount of revenues necessary for a utility to <u>provide safe and reliable service</u> while having an opportunity to earn a reasonable return on their investments.

- The IURC is required by law to be an impartial fact-finding body and hears evidence in cases filed before it and makes decisions based on the evidence presented in those cases.

THE IURC's ROLE

- The IURC ensures that *retail* utilities are meeting their **resource adequacy requirements** (i.e. providing safe and reliable service)
- Utilities submit **integrated resource plans (IRPs)**, every 3 years demonstrating how they plan to meet their forecasted demand with a generation portfolio over the next 20 years.
  - Want lowest cost reasonably possible while maintaining flexibility.
- The IURC approves utilities building new generation facilities and ensures cost recovery for investments made in generation, transmission, and distribution infrastructure that are found prudent.

ELECTRIC UTILITY REGULATORY PARTNERS

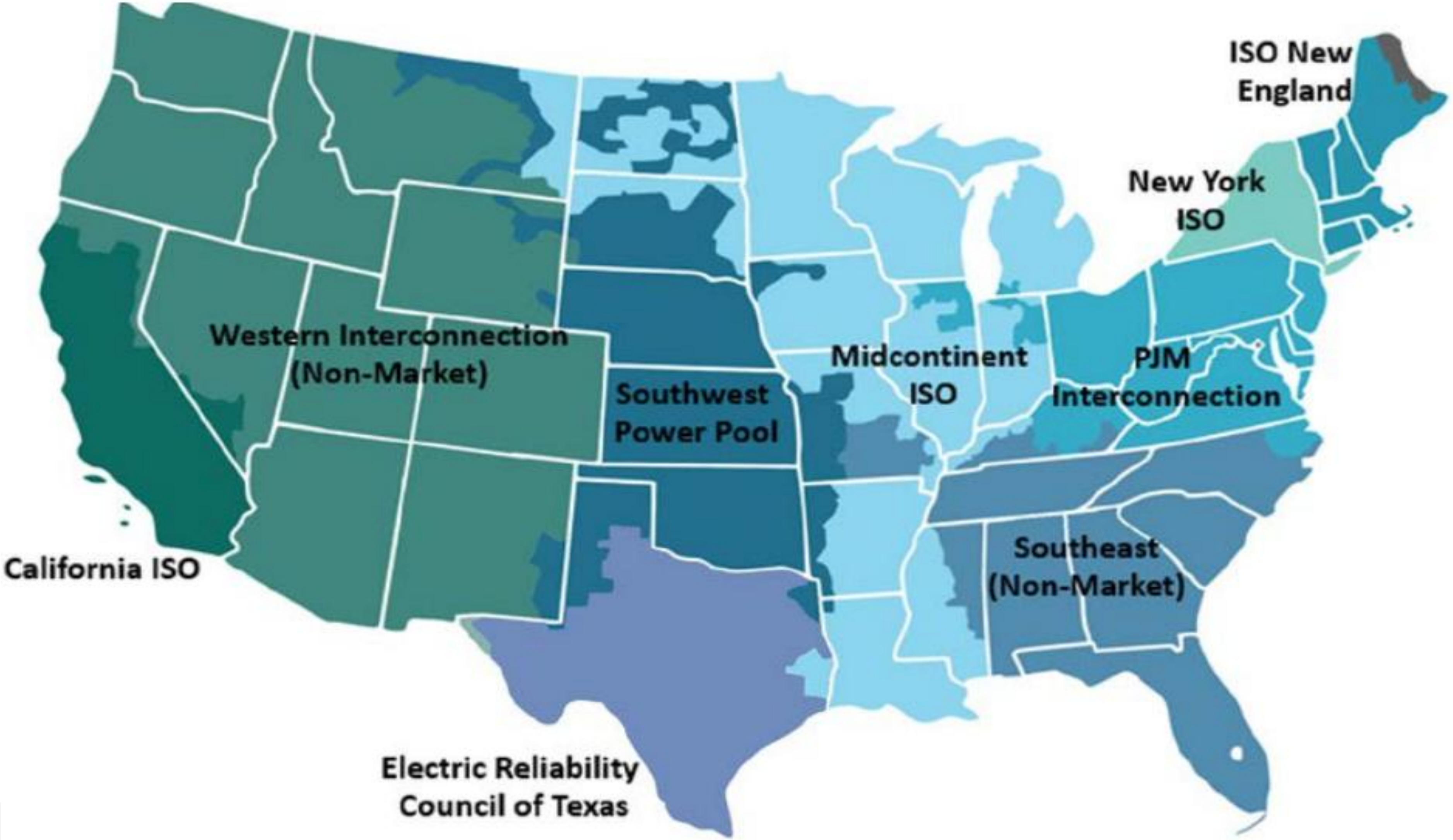
- Federal Energy Regulatory Commission (FERC)
- North American Electric Reliability Corporation (NERC)
- Regional Transmission Organizations (RTOs)
  - MISO & PJM
- ReliabilityFirst
- Nuclear Regulatory Commission (NRC)
- Indiana Department of Environmental Management (IDEM)

REGIONAL TRANSMISSION ORGANIZATIONS (RTOS)

- RTOs are independent organizations that plan and control the transmission grid to improve the economics and reliability of the wholesale electric markets.

- They provide three main functions:
  - **Planning** - transmission system and regional resource needs.
  - **Operations** – matches supply with demand by coordinating generation output and transmission.
    - Think air traffic controller for electrons.
  - **Markets** – provides economic dispatch of resources to ensure the lowest cost combination of resources are used.
    - Think stock market for electrons.

REGIONAL TRANSMISSION ORGANIZATIONS (RTOS)



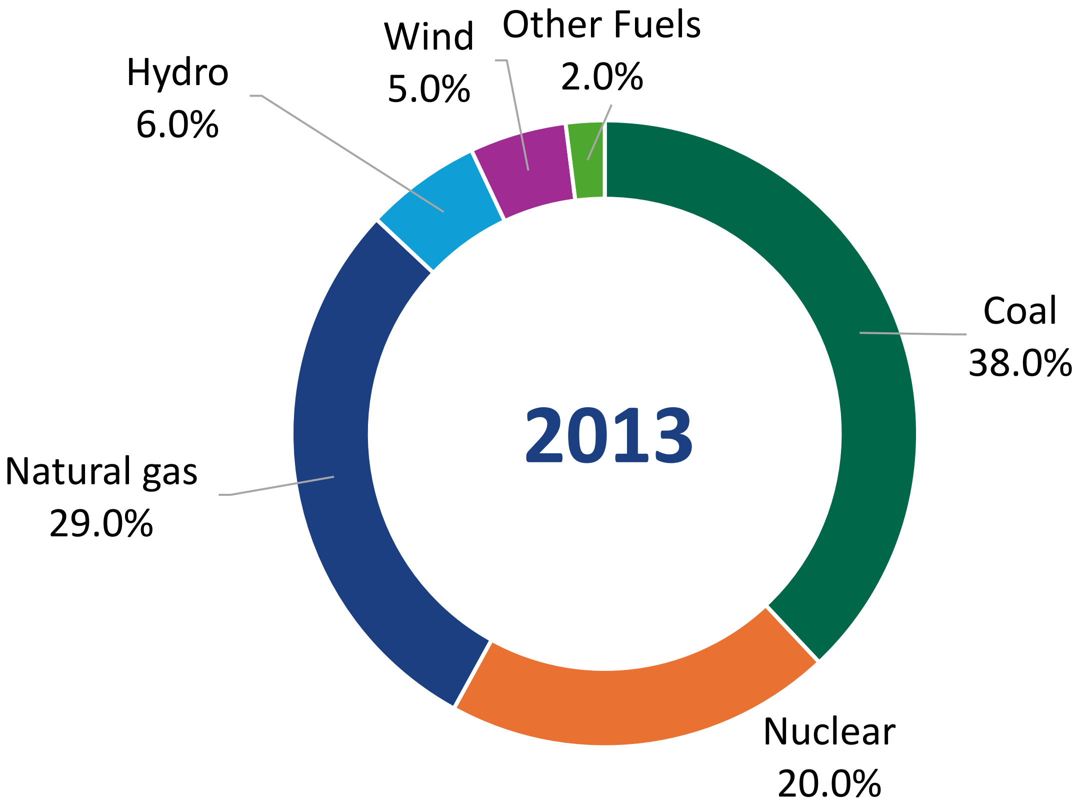
REGIONAL TRANSMISSION ORGANIZATIONS (RTOS)

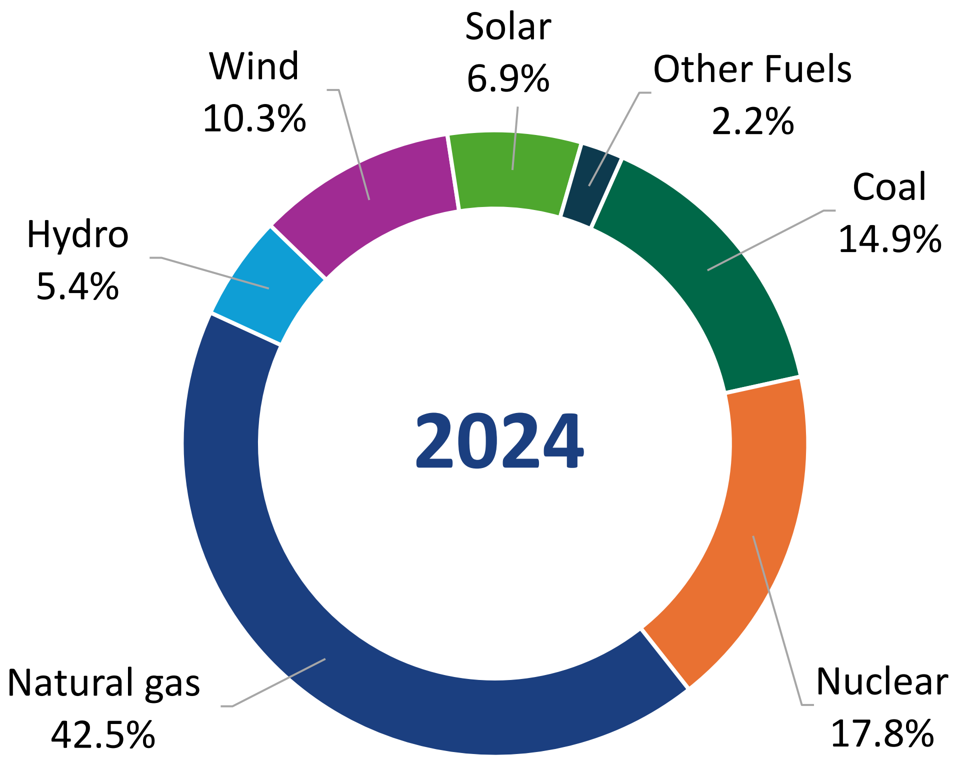
- MISO includes Duke Energy, CenterPoint Energy, NIPSCO, AES Indiana, and Hoosier Energy.
- PJM encompasses Indiana Michigan Power.
- Indiana Municipal Power Agency & Wabash Valley Power Alliance participate in both RTOs.

GENERATION PLANNING & TRANSITION

Generation Mix Transition

United State’s Generation Fuel Mix

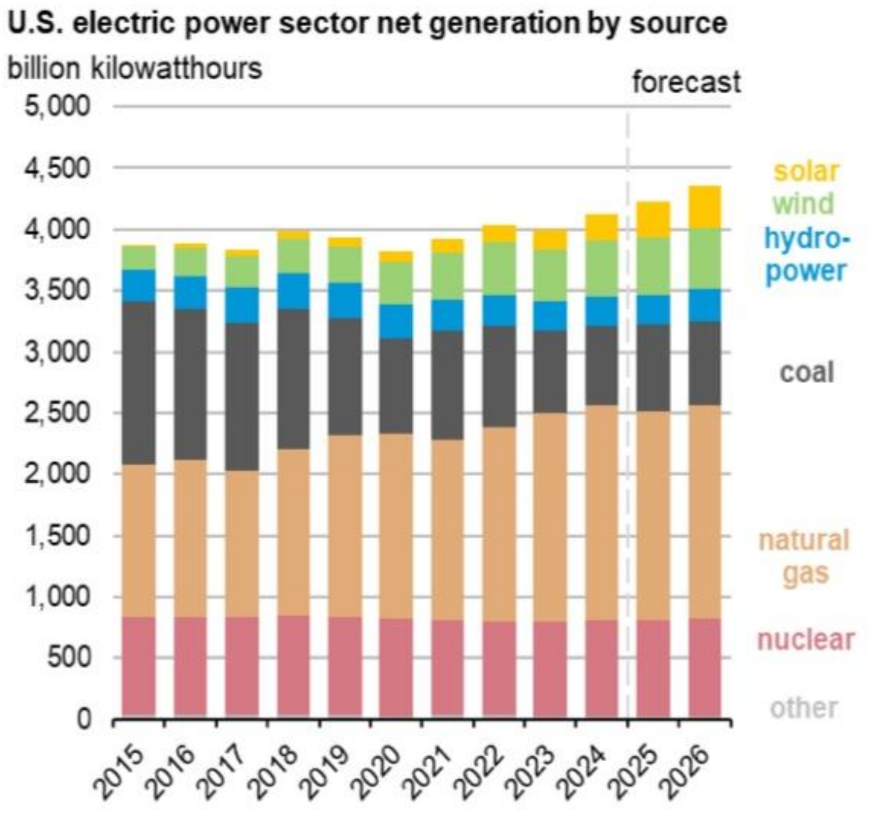




**Numbers are rounded from EIA data*

Generation Mix Transition

United State’s Generation Fuel Mix

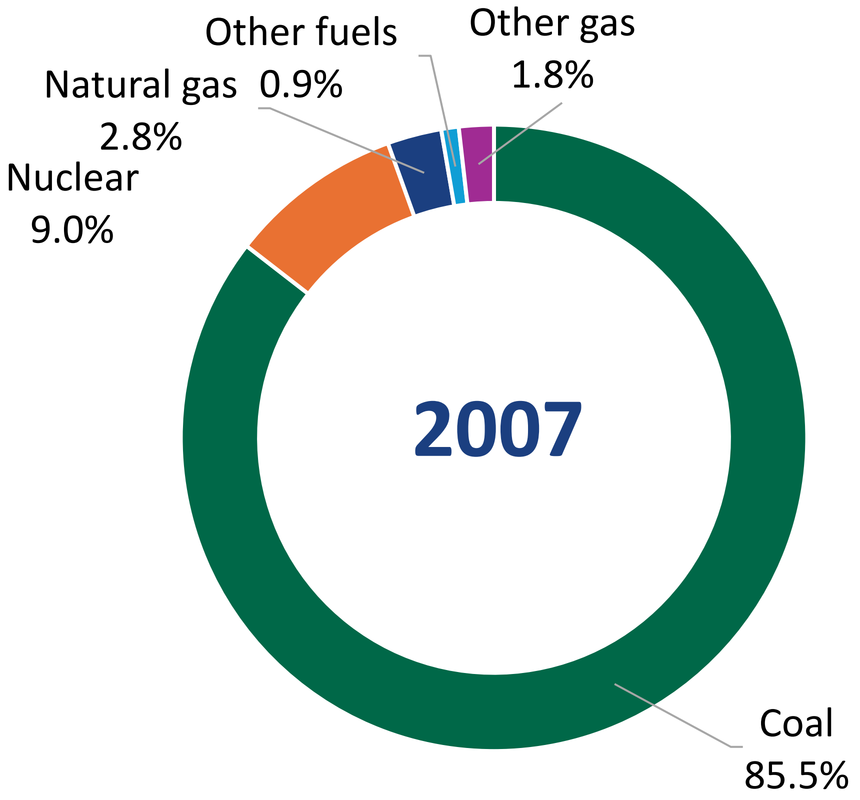


Data source: U.S. Energy Information Administration, *Short-Term Energy* (

**Numbers are rounded from EIA data*

Generation Mix Transition

Indiana’s Generation Fuel Mix



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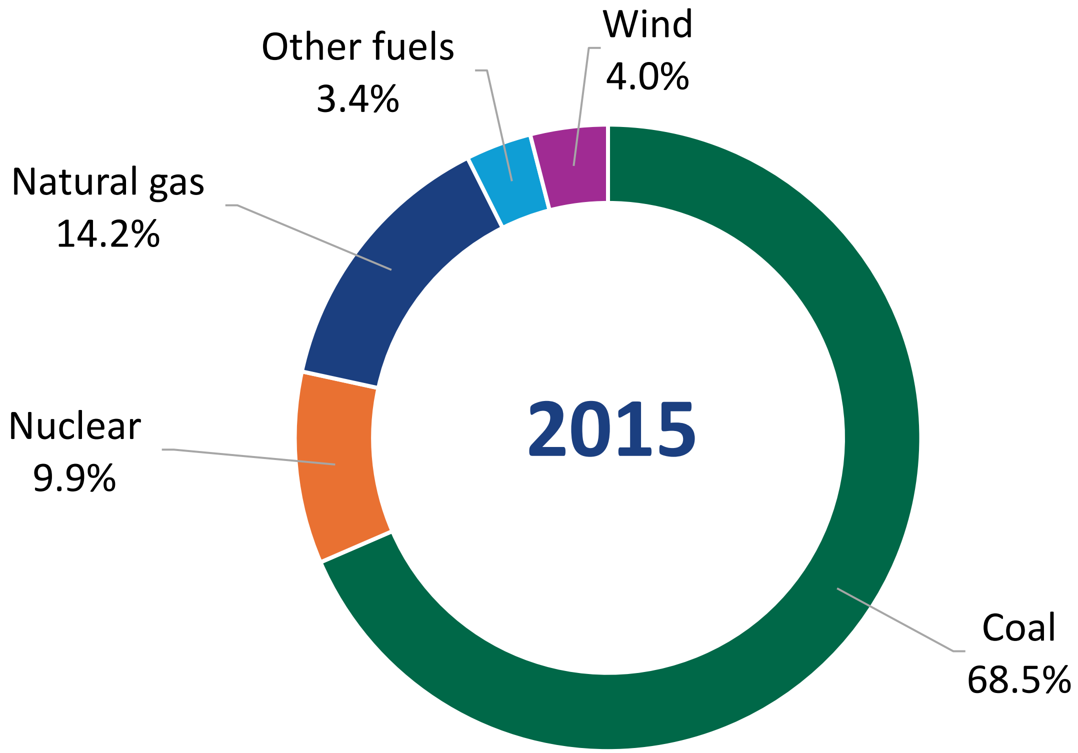
Generation Mix Transition

Indiana’s Generation Fuel Mix



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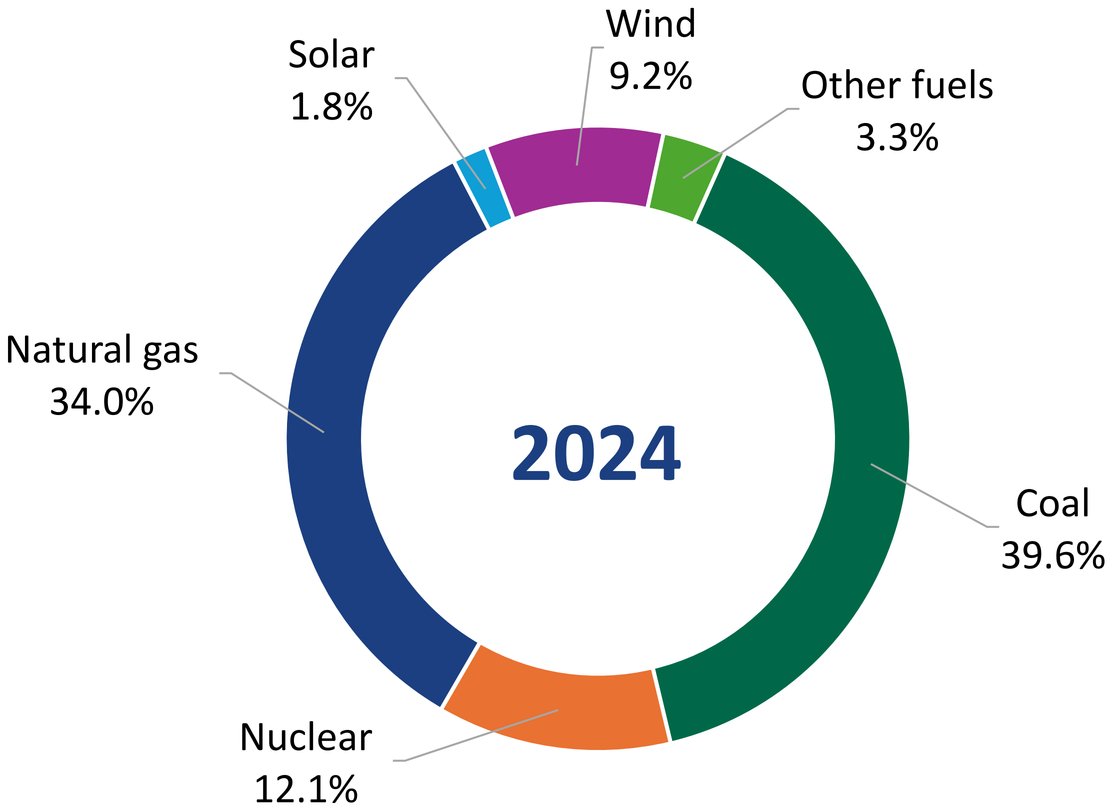
Generation Mix Transition

Indiana’s Generation Fuel Mix



**Numbers are rounded from EIA data*

Generation Mix Transition

Indiana’s Generation Fuel Mix

Resource	2007	2015	2024	Change
Coal	85.5%	68.5%	39.6%	-45.9%
Natural Gas	2.8%	14.2%	34.0%	31.2%
Nuclear	9.0%	9.9%	12.0%	3%
Wind	0%	4.0%	9.2%	9.2%
Solar	0%	0.1%	1.8%	1.8%
Other (e.g. hydro)	2.7%	3.3%	3.3%	0.6%

**Numbers are rounded from EIA data*

Generation Mix

In-State Generation Resources (Net Summer Capacity)

Resource	MW
Coal	12,721
Natural Gas	8,679
Hydro	72
Wind	3,652
Solar	3,754
Biogas	49
Other gas (e.g. CHP)	384
Petroleum	84
Total	**29,394**
Cook Nuclear Plant	1,460 (IN customers)

- This includes every generation resource in the state that reports data to EIA, including private generation resources, such as industrial combined heat and power (CHP) units .

Source: EIA 860-M (August 2025)

Generation Mix

Generation Resources Serving Hoosier Customers

Resource	MW
Coal	10,290
Natural Gas	7,083
Hydro	56
Wind	2,256
Solar	2,665
Biogas	17
Petroleum	48
Cook Nuclear Plant	1,460
Total	**23,875**

- Generation resources used by retail utilities to serve Hoosiers
- Does not include resources below 10MW
- Does not include short-term capacity contracts or power purchase agreements between utilities

Source: IURC 2025 Annual Report

What Do These Charts Show?

- Electric generation transition happening slowly but surely

- What has been the story over the last 20 years?
  - Retirements of thermal generation (coal, oil, and some natural gas)
  - The growth of renewable generation (wind and solar)
  - The growth of natural gas generation

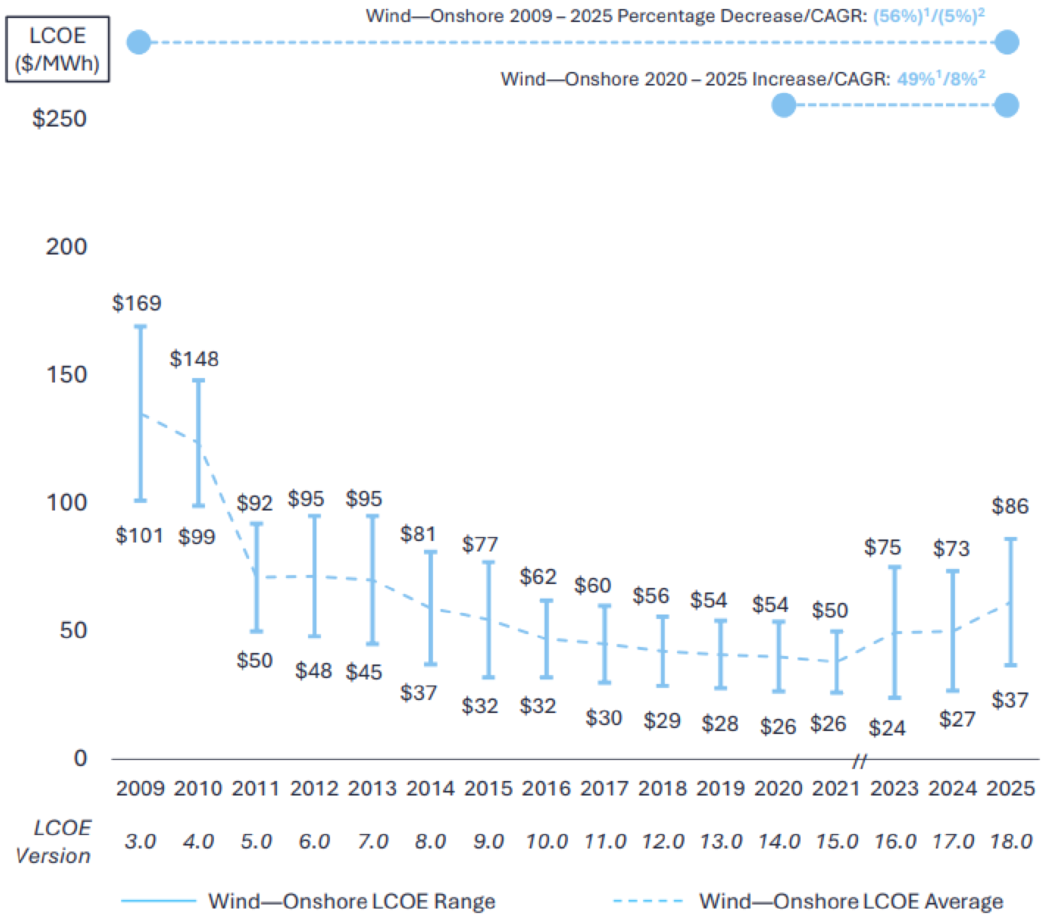
- What is behind the transition?
  - Energy market economics
  - Federal and state policies
  - Aging generation plants (natural build cycle)

What Has Driven Renewable Energy Growth?

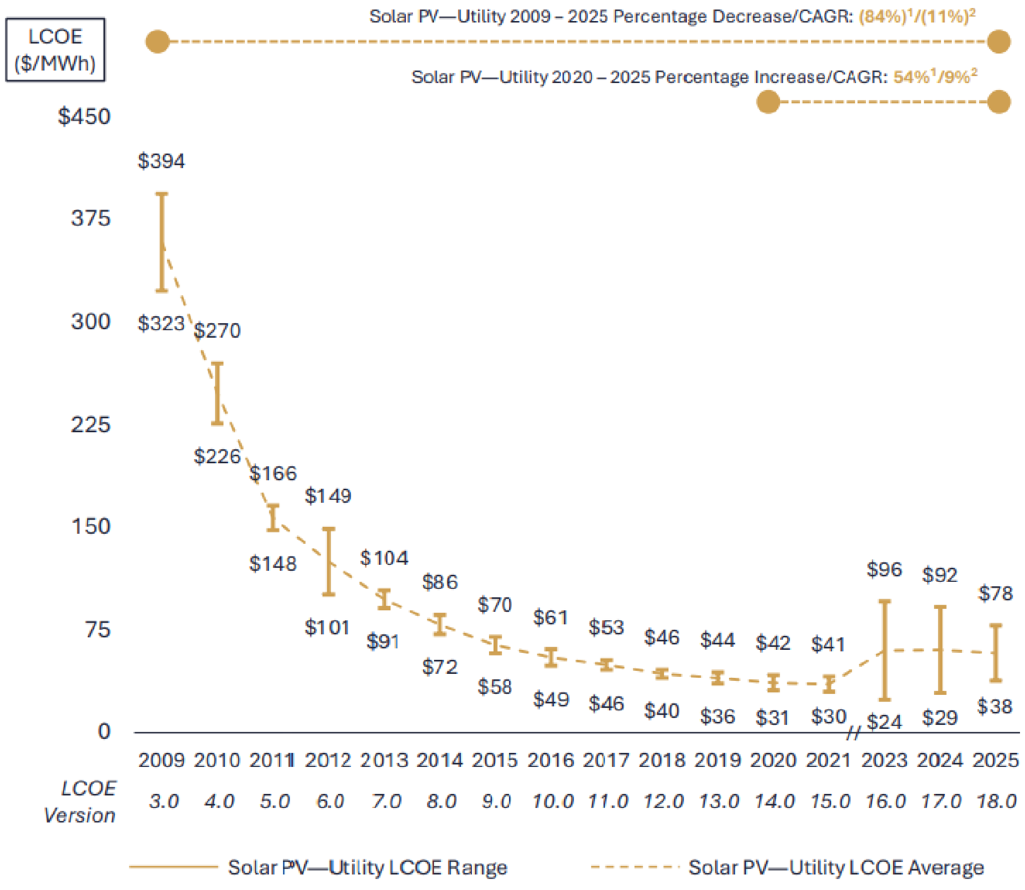
- Relatively lower capital costs compared to traditional thermal generation.
  - Capital costs have decreased over time as renewable energy manufacturing and commercialization grew.
- No fuel costs to produce electricity & lower maintenance costs.
- Favorable tax treatment (production & investment tax credits)

What Has Driven Renewable Energy Growth?

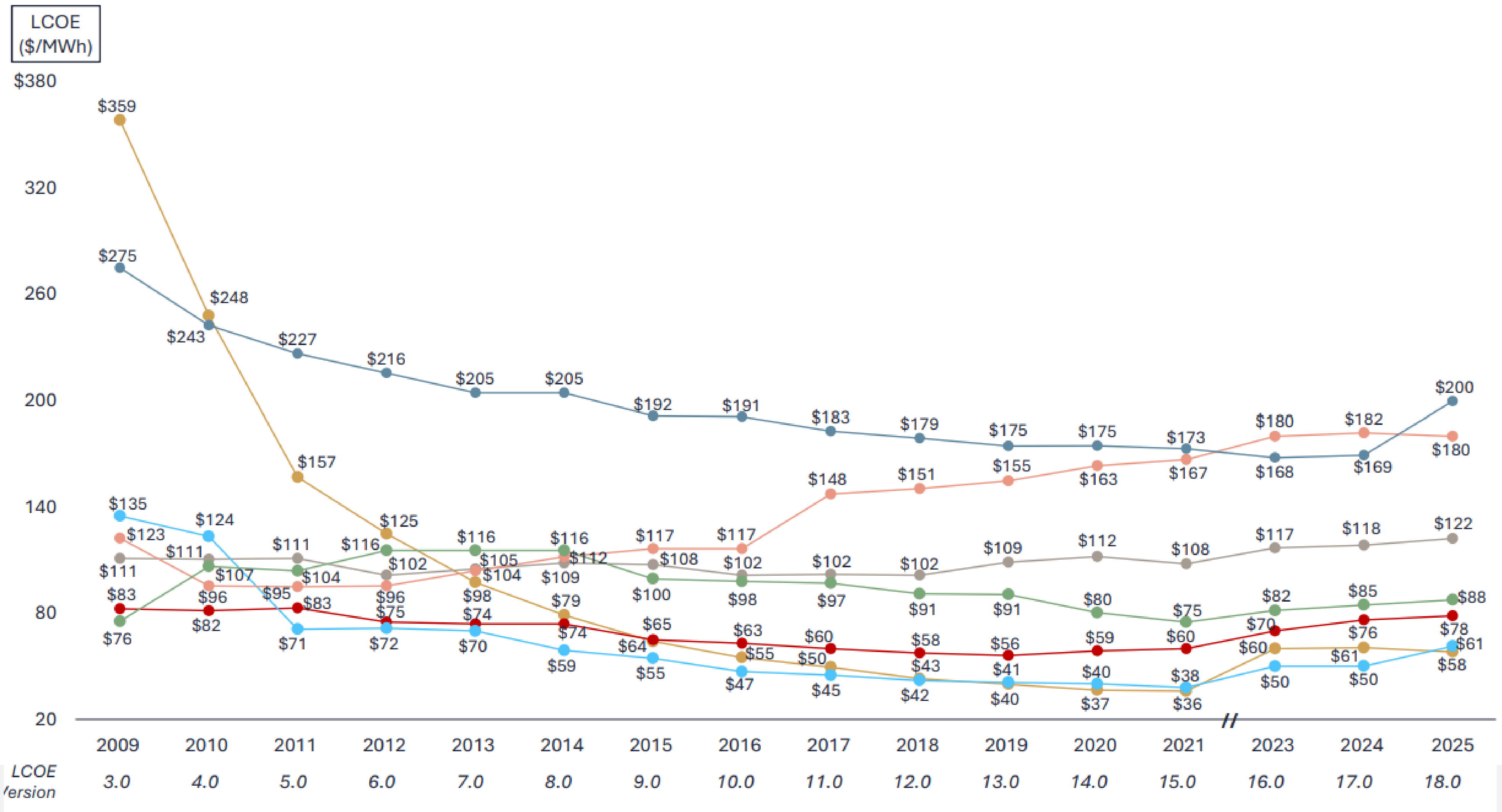
Wind—Onshore



Solar PV—Utility



How Do “Costs” Compare?



Selected Historical Average LCOE Values¹

Since v3.0	Since v17.0
Gas Peaking (27%)	Gas Peaking 18%
U.S. Nuclear² 47%	U.S. Nuclear² (1%)
Coal 10%	Coal 3%
Geothermal 16%	Geothermal 3%
Gas Combined Cycle (5%)	Gas Combined Cycle 3%
Wind—Onshore (55%)	Wind—Onshore 23%
Solar PV—Utility (84%)	Solar PV—Utility (4%)

RESOURCE ADEQUACY

What is Resource Adequacy?

- Simply put, resource adequacy is the ability of an electric utility to serve all of its customers during highest moment of demand (peak demand) in the year.

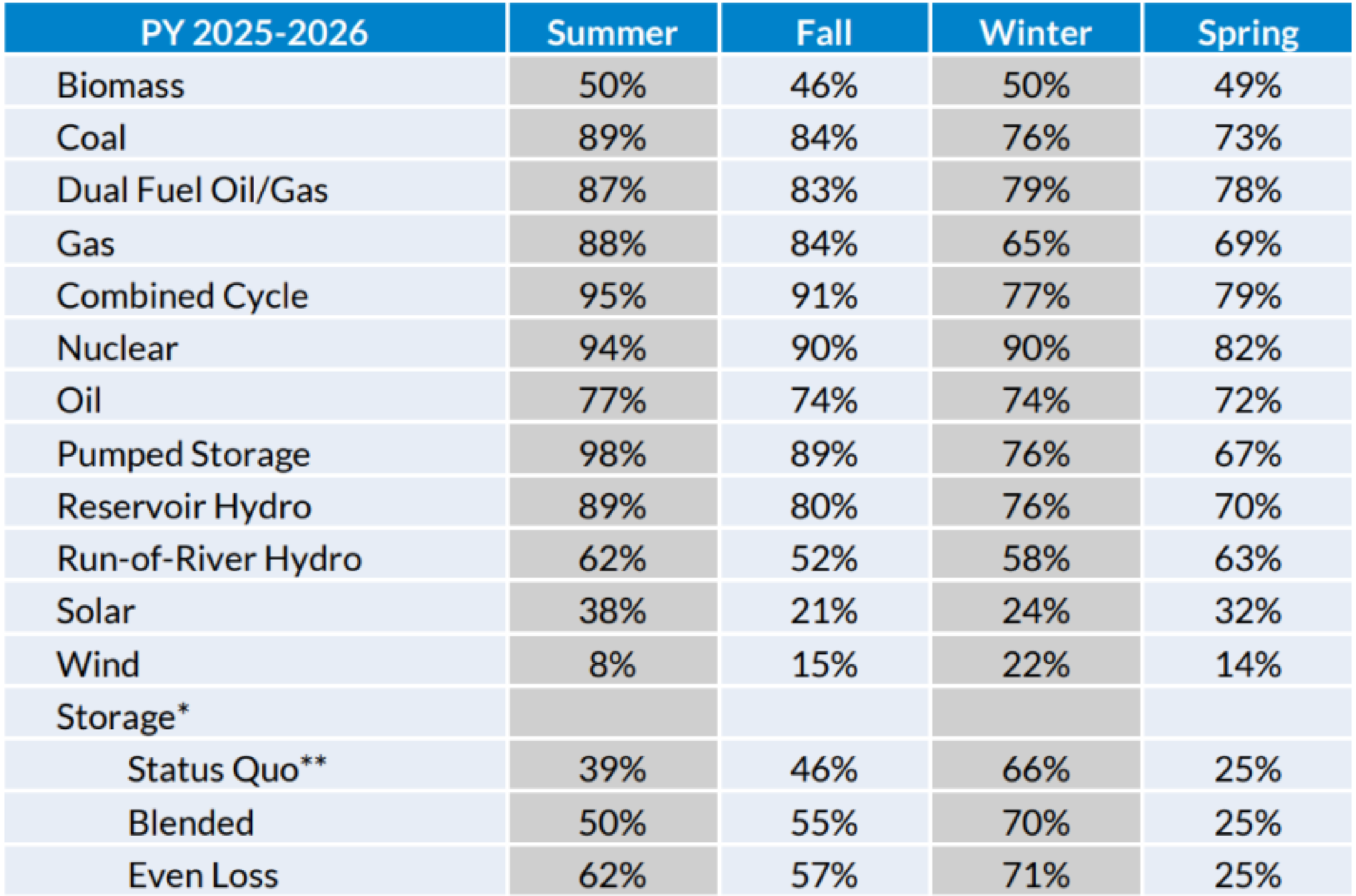
- Utilities plan to meet this peak demand plus a reserve margin to account for unplanned outages or other issues that may happen.
    - Remember, retail electric utilities have an obligation to provide safe and reliable service

- Participating in an RTO improves system reliability and economics.

Why Are We Hearing About This Now?

- Installed capacity ≠ production at time of system need.
- RTOs use accredited capacity to determine value of generation resources.
- Renewable generation accredited capacity is much lower than thermal generation.

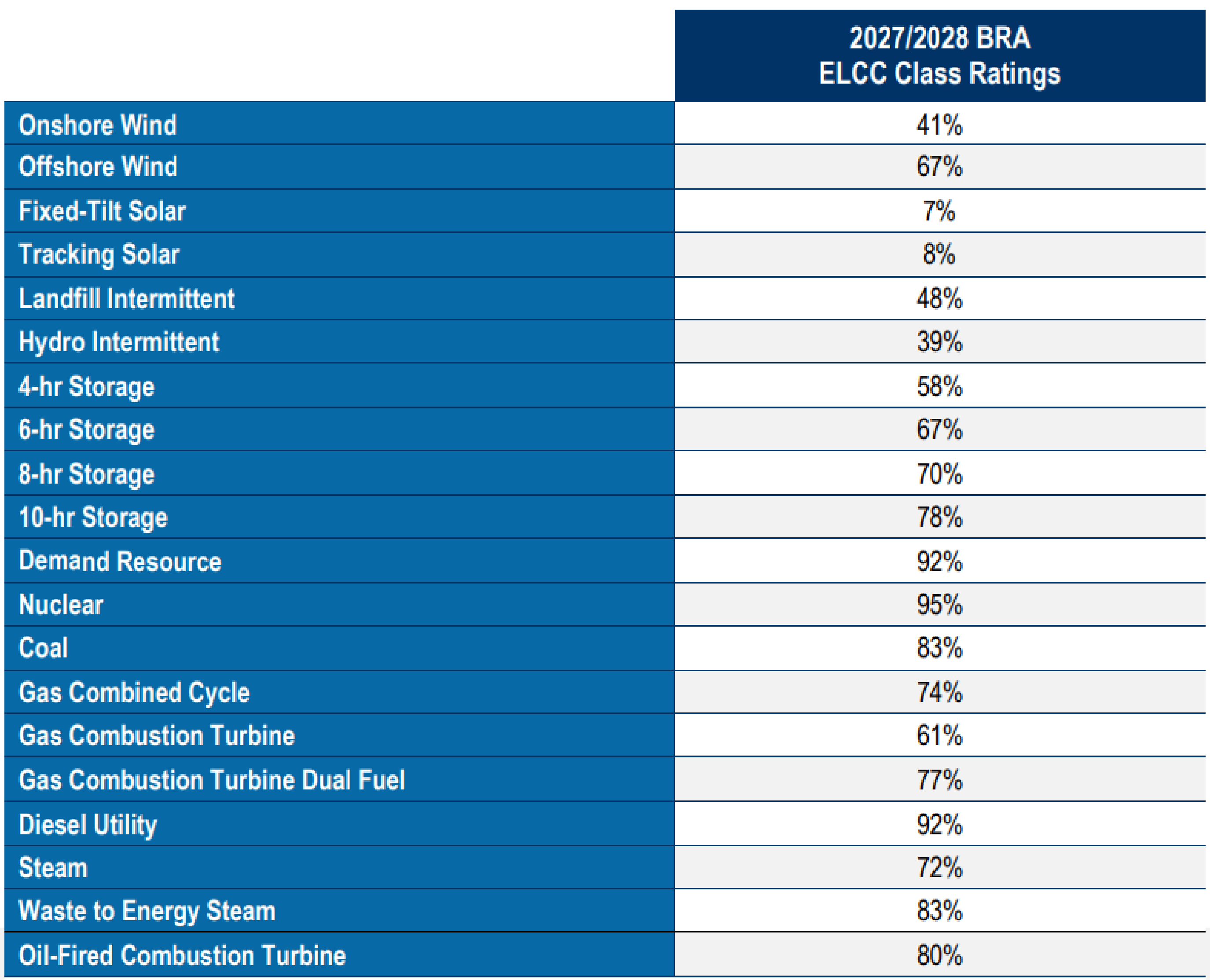
ACCREDITED OR EFFECTIVE CAPACITY



PY 2025-2026	Summer	Fall	Winter	Spring
Biomass	50%	46%	50%	49%
Coal	89%	84%	76%	73%
Dual Fuel Oil/Gas	87%	83%	79%	78%
Gas	88%	84%	65%	69%
Combined Cycle	95%	91%	77%	79%
Nuclear	94%	90%	90%	82%
Oil	77%	74%	74%	72%
Pumped Storage	98%	89%	76%	67%
Reservoir Hydro	89%	80%	76%	70%
Run-of-River Hydro	62%	52%	58%	63%
Solar	38%	21%	24%	32%
Wind	8%	15%	22%	14%
Storage*				
Status Quo**	39%	46%	66%	25%
Blended	50%	55%	70%	25%
Even Loss	62%	57%	71%	25%

- MISO DLOL Accreditation
- Notice that nuclear receives a much higher accreditation that both solar and wind resources in each season

ACCREDITED OR EFFECTIVE CAPACITY



	2027/2028 BRA ELCC Class Ratings
Onshore Wind	41%
Offshore Wind	67%
Fixed-Tilt Solar	7%
Tracking Solar	8%
Landfill Intermittent	48%
Hydro Intermittent	39%
4-hr Storage	58%
6-hr Storage	67%
8-hr Storage	70%
10-hr Storage	78%
Demand Resource	92%
Nuclear	95%
Coal	83%
Gas Combined Cycle	74%
Gas Combustion Turbine	61%
Gas Combustion Turbine Dual Fuel	77%
Diesel Utility	92%
Steam	72%
Waste to Energy Steam	83%
Oil-Fired Combustion Turbine	80%

- PJM ELCC Accreditation
- Notice again how nuclear performs very well.

ACCREDITED OR EFFECTIVE CAPACITY

- Morgan Stanley Annual Energy Paper (2023):
  - "…we computed the amount of natural gas that can be disconnected when adding solar and wind to meet another 10% of demand. The result: due to wind and solar intermittency and the need to meet demand and maintain system reliability, **only 10-30 MW of natural gas could be disconnected for every 100 MW of new wind and solar capacity.** These capacity credits decline as more wind and solar are added to the system..."

WHAT ARE THE GRID OPERATORS SAYING?

1

PJM

- Retirements are at risk of outpacing new resources, due to a combination of industry forces including siting and supply chain issues; 95% of the PJM generation queue is renewables with completion rates of just 5%.

2

MISO

- Studies conducted by MISO indicate it is possible to reliably operate an electric system that has far fewer conventional power plants and far more zero-carbon resources than we have today. However, the transition that is underway to get to a decarbonized end state is posing material, adverse challenges to electric reliability.

3

NERC

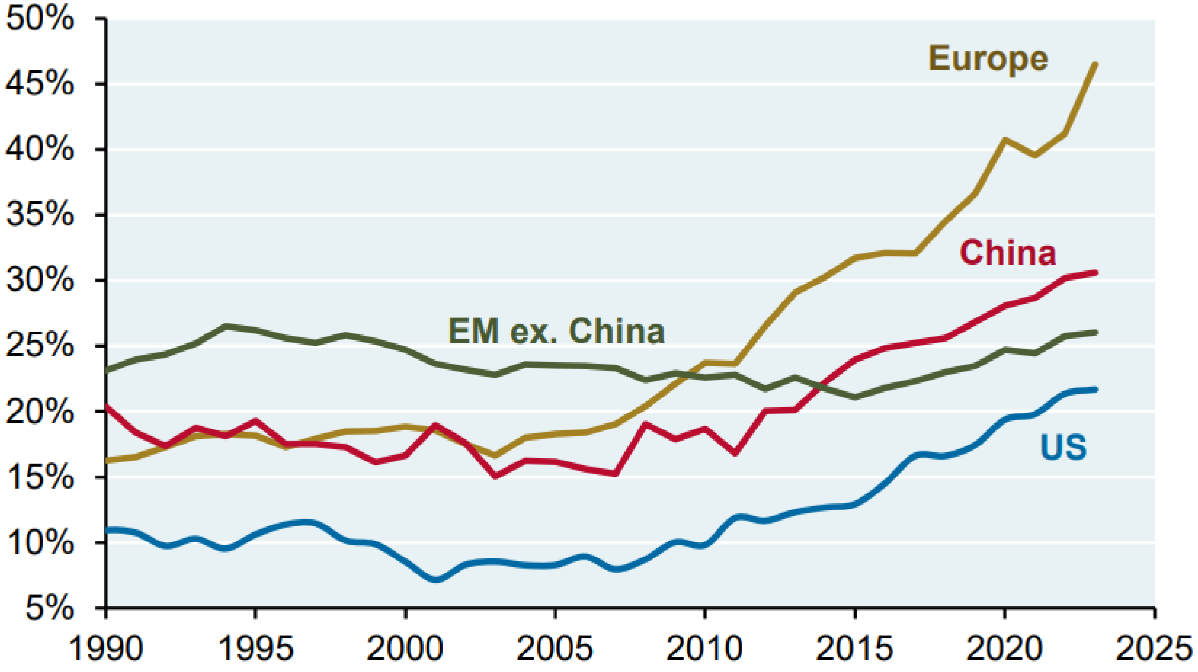
- In 2023, for the first time, NERC considered “energy policy” among the five significant evolving and interdependent risks to grid reliability.

WHY IS THIS IMPORTANT TO GET RIGHT?

- Europe has struggled with electricity costs due to decarbonization efforts.

Renewable share of electricity consumption

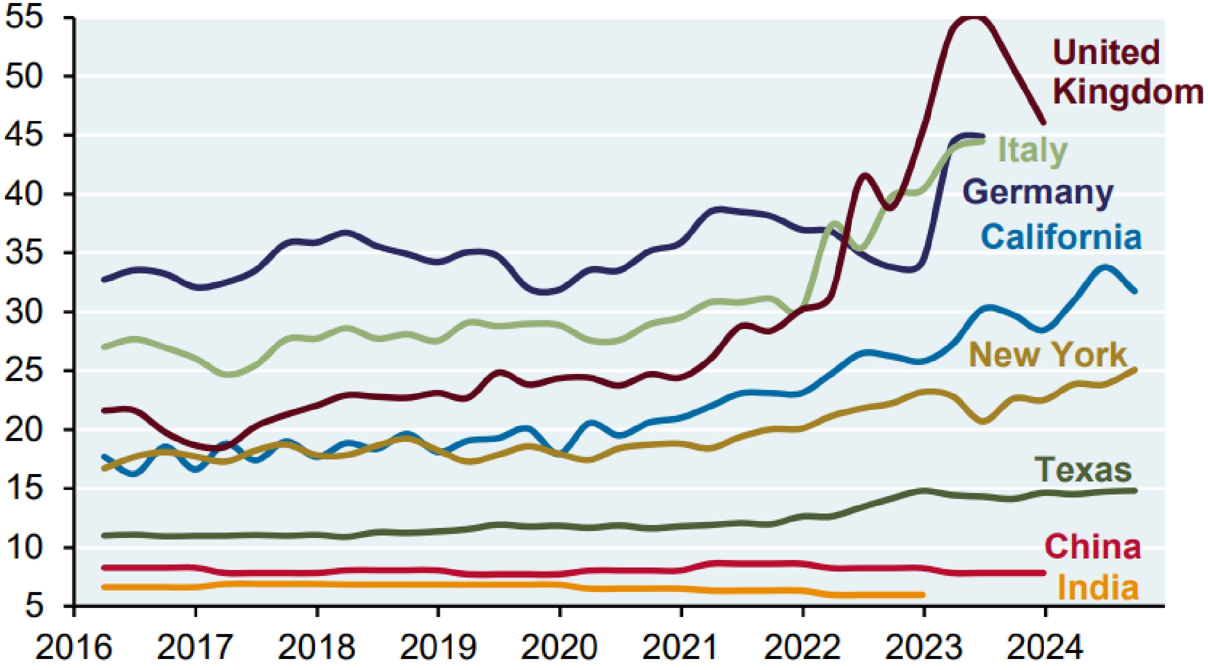
Percent



Source: EI Statistical Review of World Energy, IEA, JPMAM, 2024

Residential electricity prices

US$, cents per kWh



Source: EIA, IEA, JPMAM, Q3 2024

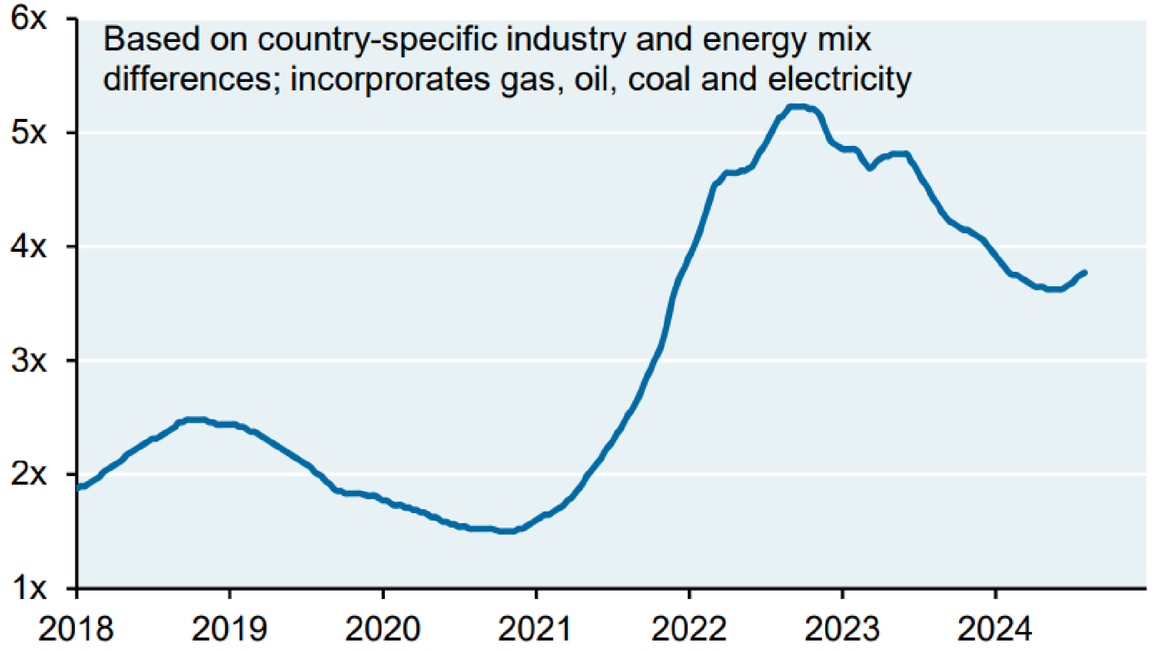
Source: J.P. Morgan 2025 Annual Energy Paper

WHY IS THIS IMPORTANT TO GET RIGHT?

- Europe has struggled with electricity costs due to decarbonization efforts.

Energy prices in the Euro area relative to the US

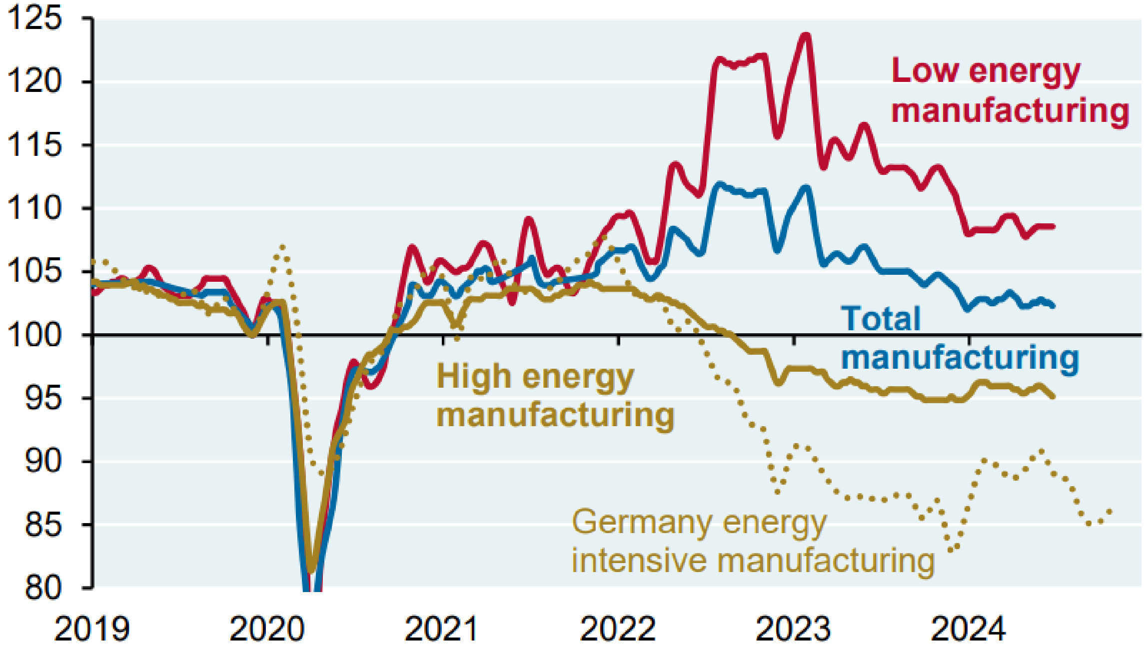
Ratio, 12 month moving average



Source: ECB Monetary Policy Report, 2024

European manufacturing output by energy intensity

Index (100 = December 2019)



Source: ECB, German Federal Statistical Office, November 2024

Source: J.P. Morgan 2025 Annual Energy Paper

INTEGRATED RESOURCE PLANNING

INDIANA OFFICE OF ENERGY DEVELOPMENT

Integrated Resource Planning

- Retail-serving electric utilities in the state are required to submit Integrated Resource Plans (IRPs) every 3 years.

- The five investor-owned electric utilities, the Indiana Municipal Power Agency (IMPA), Hoosier Energy, and Wabash Valley Power Alliance (WVPA) file IRPs.
    - IMPA has 61 municipal utility members
    - Hoosier Energy has 17 REMC members
    - WVPA has 21 REMC members

Integrated Resource Planning

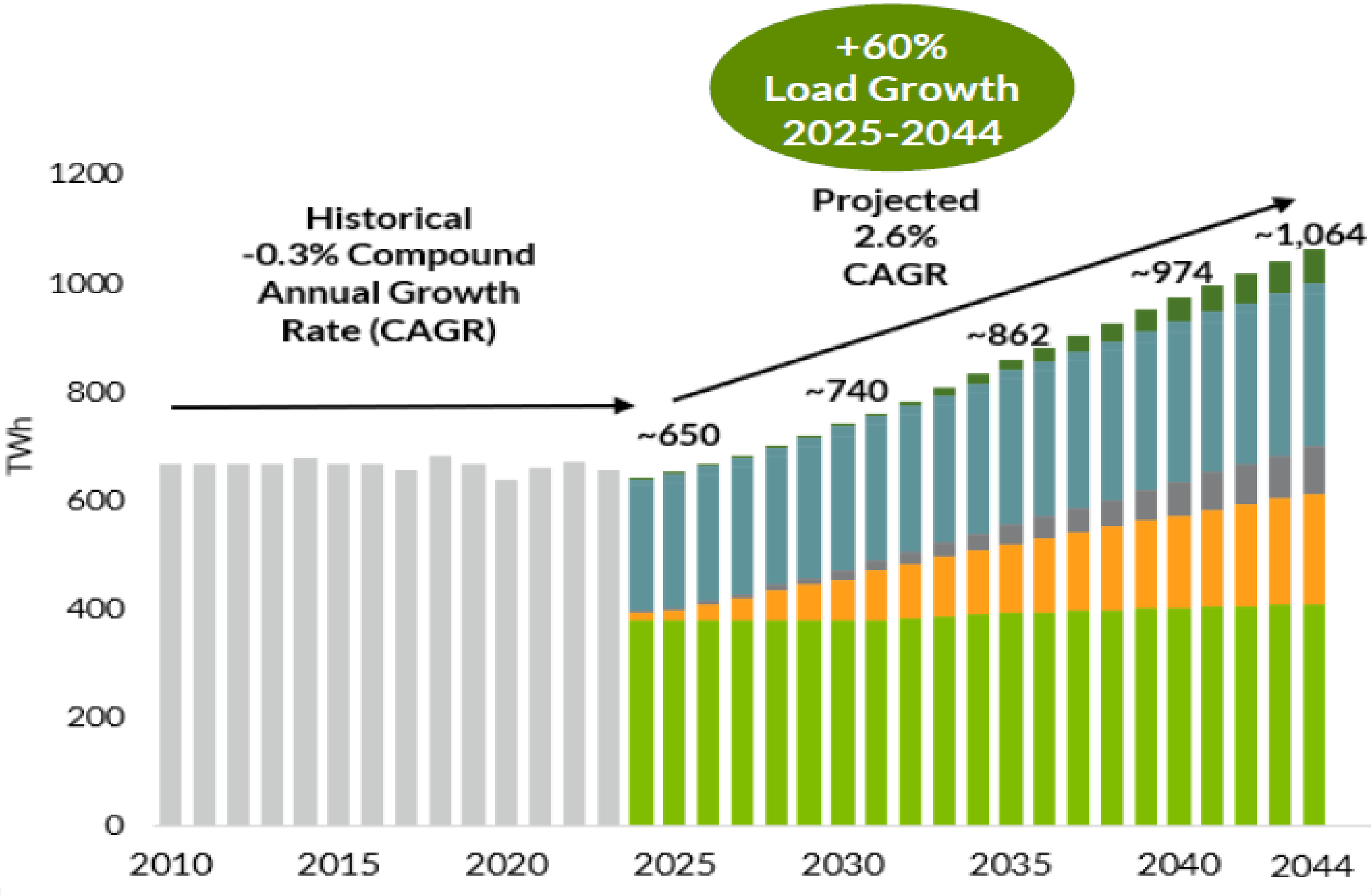
- IRPs are 20-year power resource plans that help guide generation investments for the utility.
- The objective is to provide safe and reliable power at the lowest delivered cost reasonably possible.
- However, IRPs must be flexible to account for changing economics, public policy, and electric demand.

Integrated Resource Planning

- IRP in the recent past have generally shown that investments in natural gas and renewable energy resources will likely provide the best long-term value for ratepayers.
    - Fracking and improved technology reduced the cost of natural gas, especially compared to the cost of coal.
    - Environmental policies and aging coal plants hurt the economics of continuing to operate coal plants.
    - Renewable energy costs declined significantly.

Load Growth is Back!

- Both MISO & PJM are expecting large load growth rates



Load Growth is Back!

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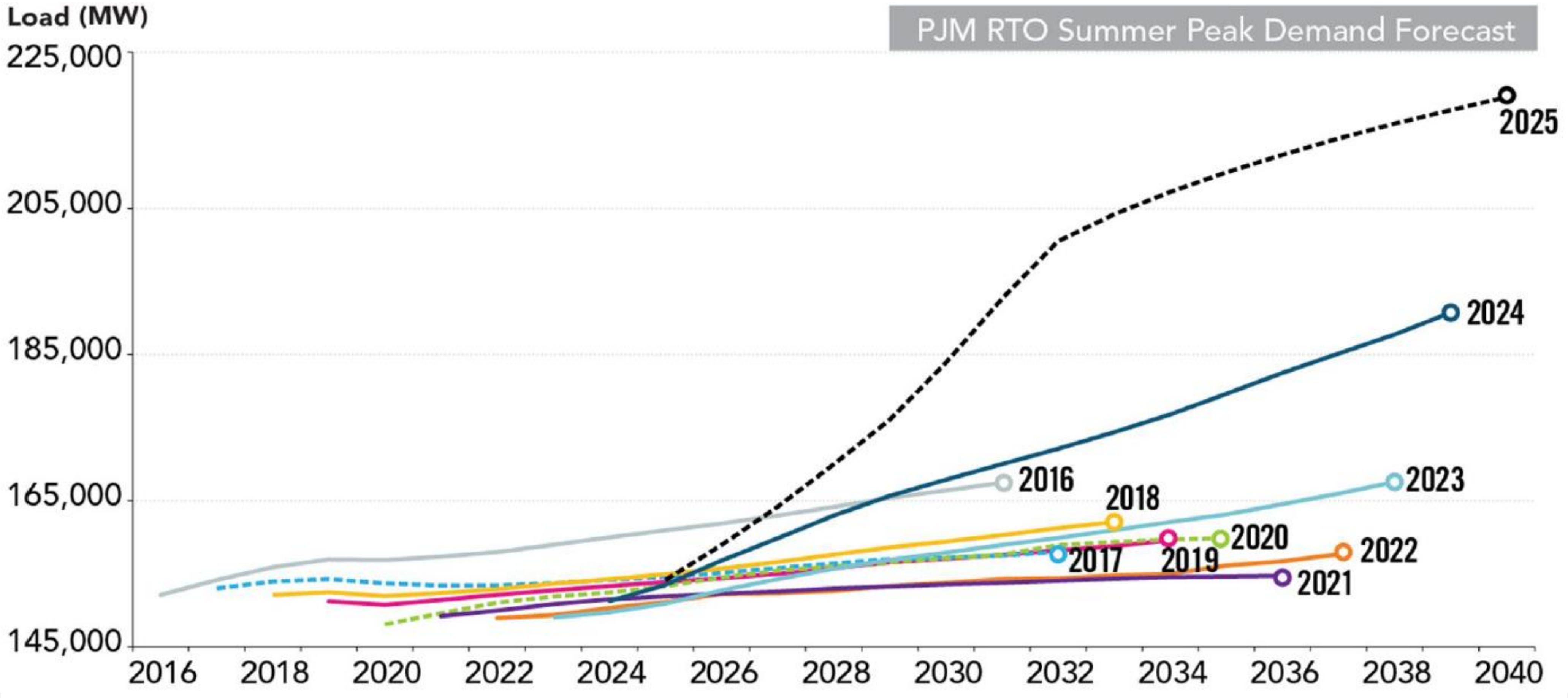


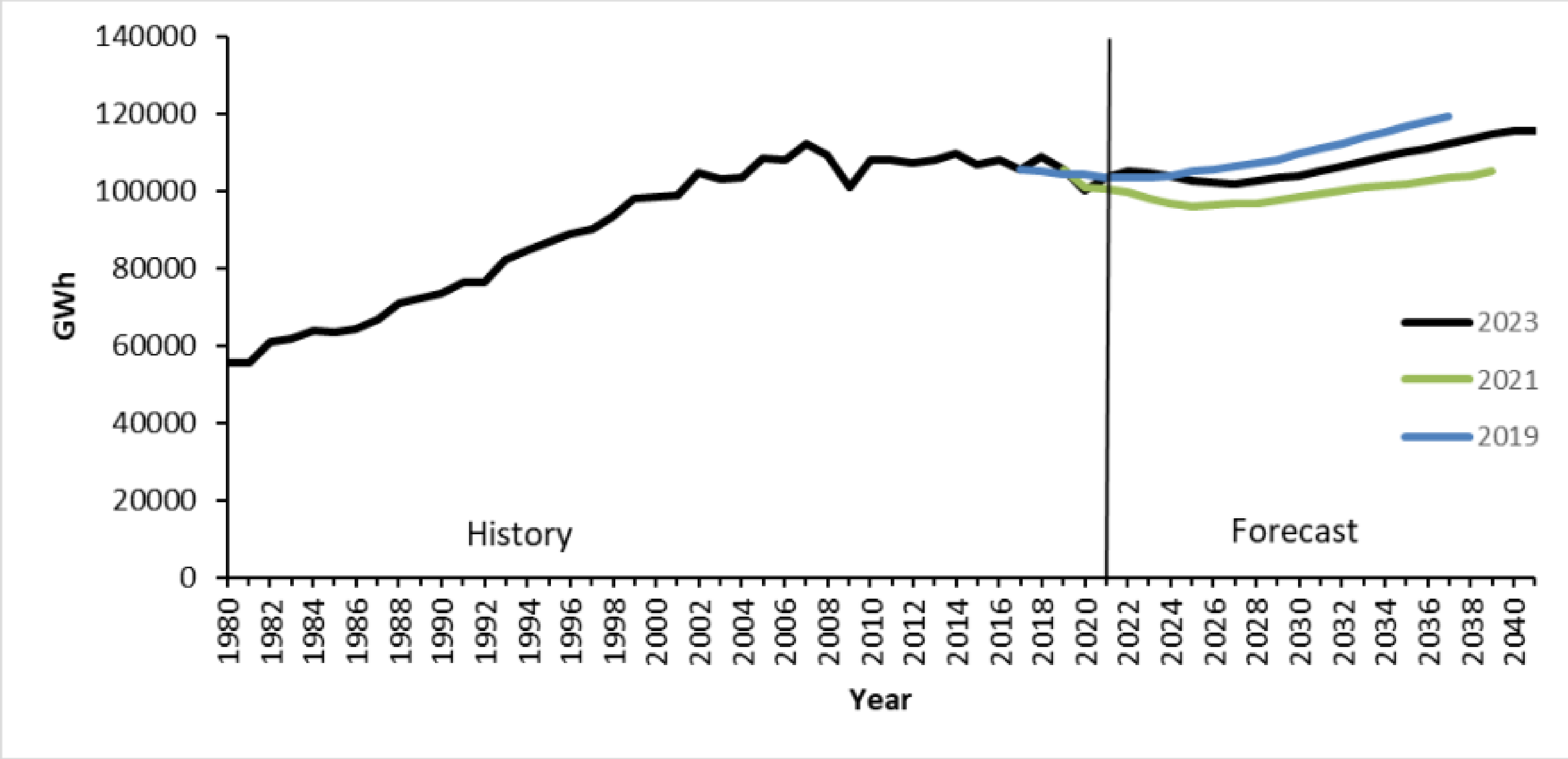
What About Indiana?

- The State Utility Forecasting Group, operated out of Purdue University, will have its new biennial state forecast out in early December.
  - 40 years of experience in forecasting electricity demand in Indiana.

PURDUE UNIVERSITY | State Utility Forecasting Group (SUFG)

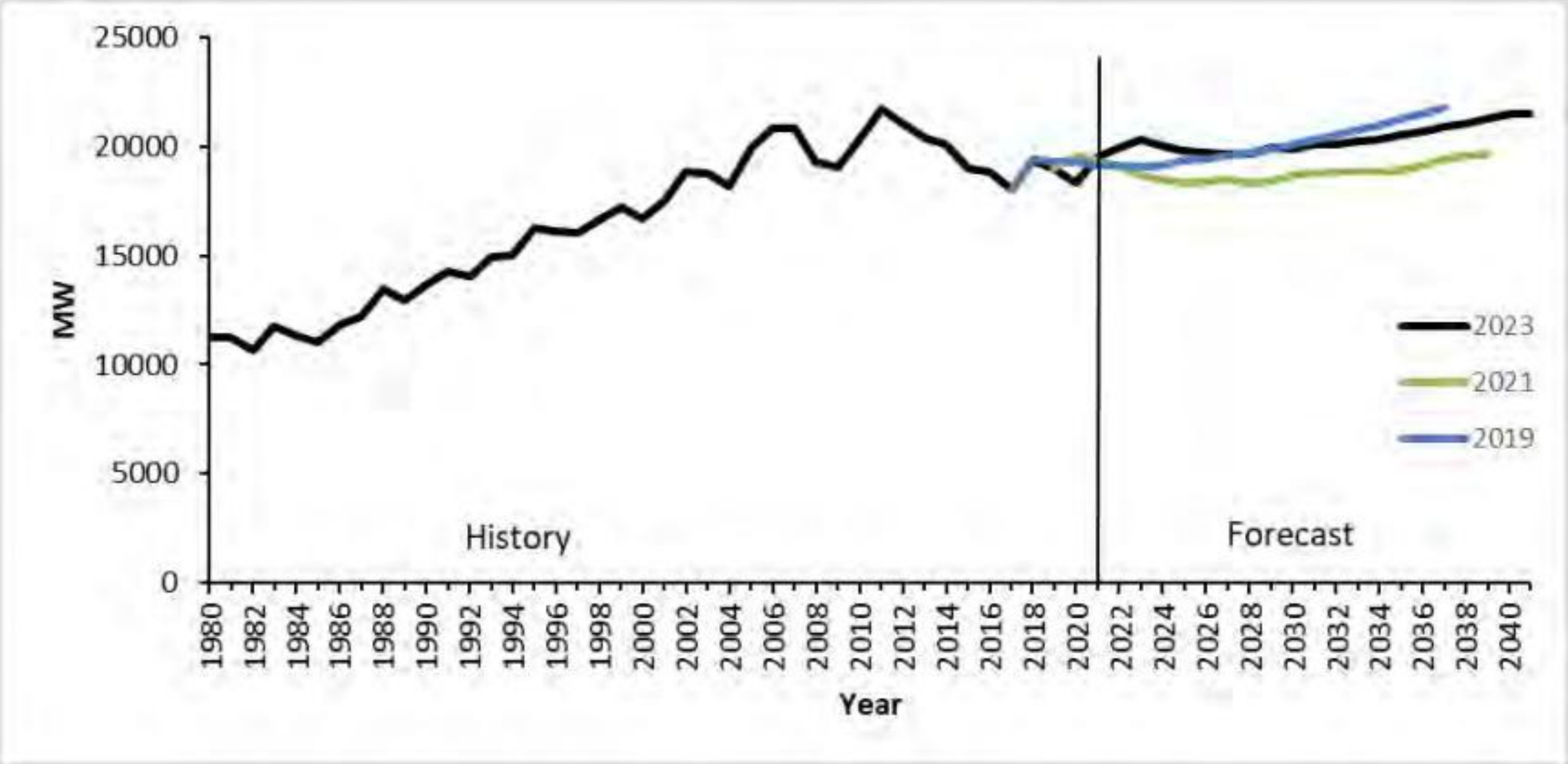
What About Indiana?

Figure 3-1. Indiana Electricity Requirements in GWh (Historical, Current, and Previous Forecasts)

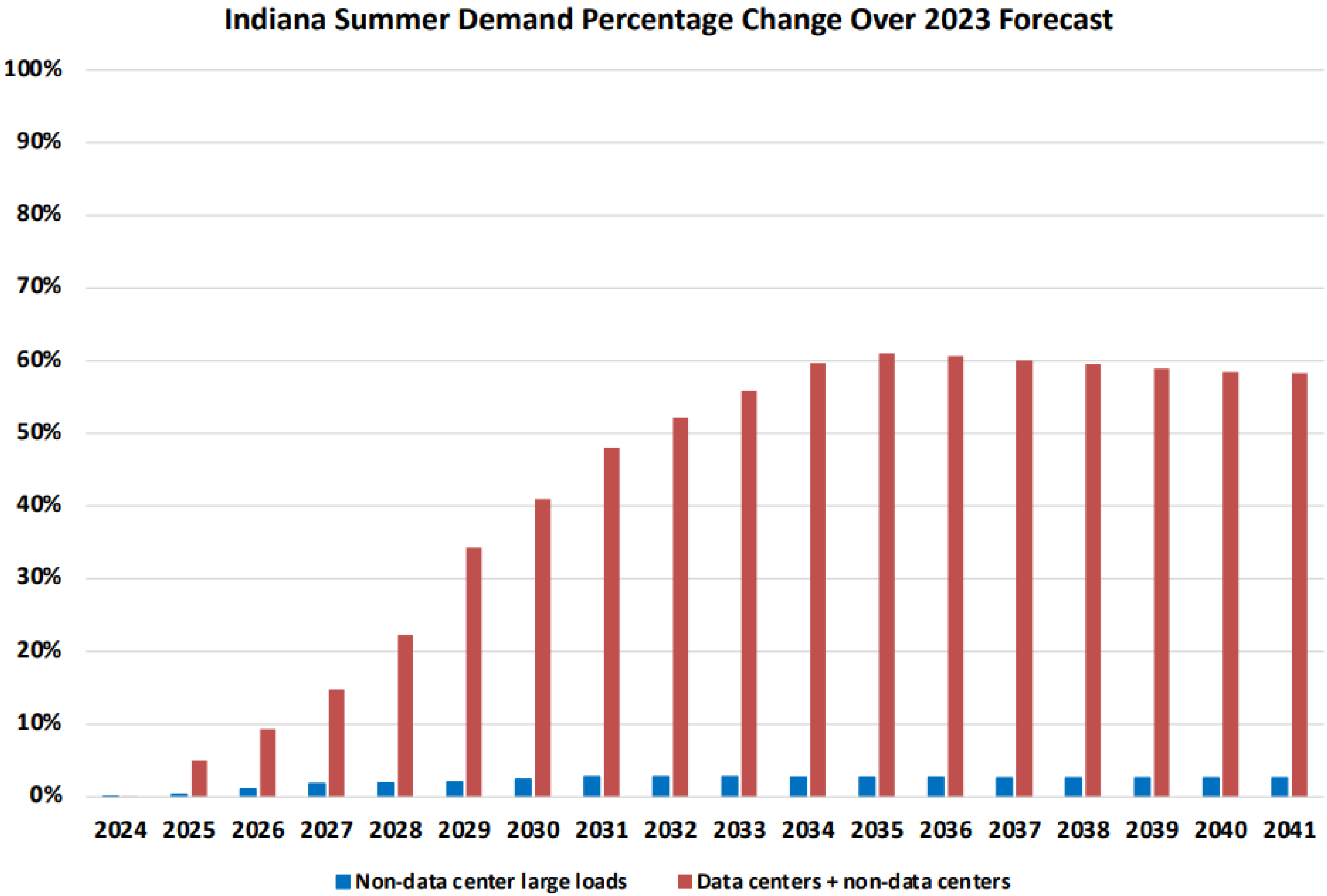


Integrated Resource Planning

Figure 3-2. Indiana Peak Demand Requirements in MW (Historical, Current, and Previous Forecasts)

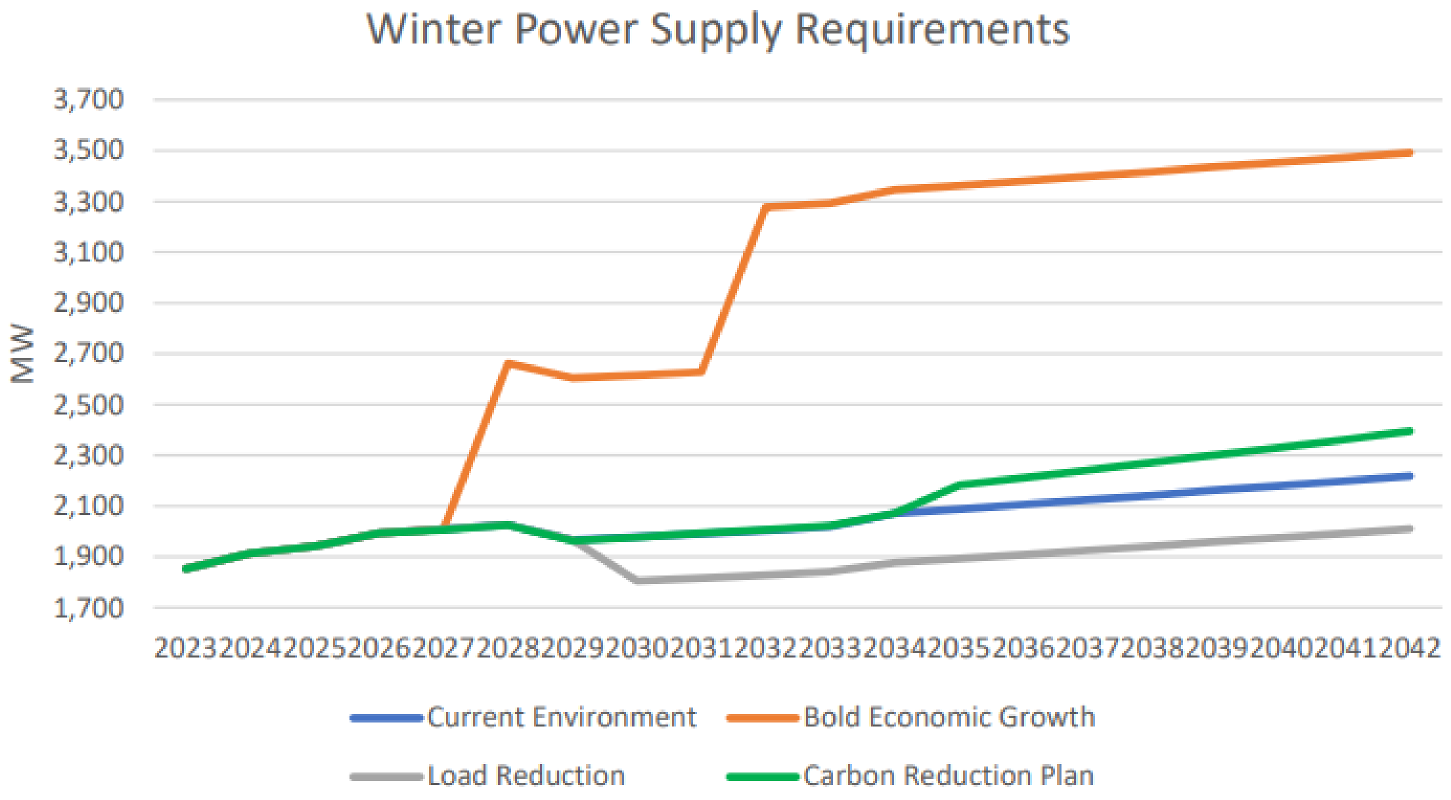


What About Indiana?



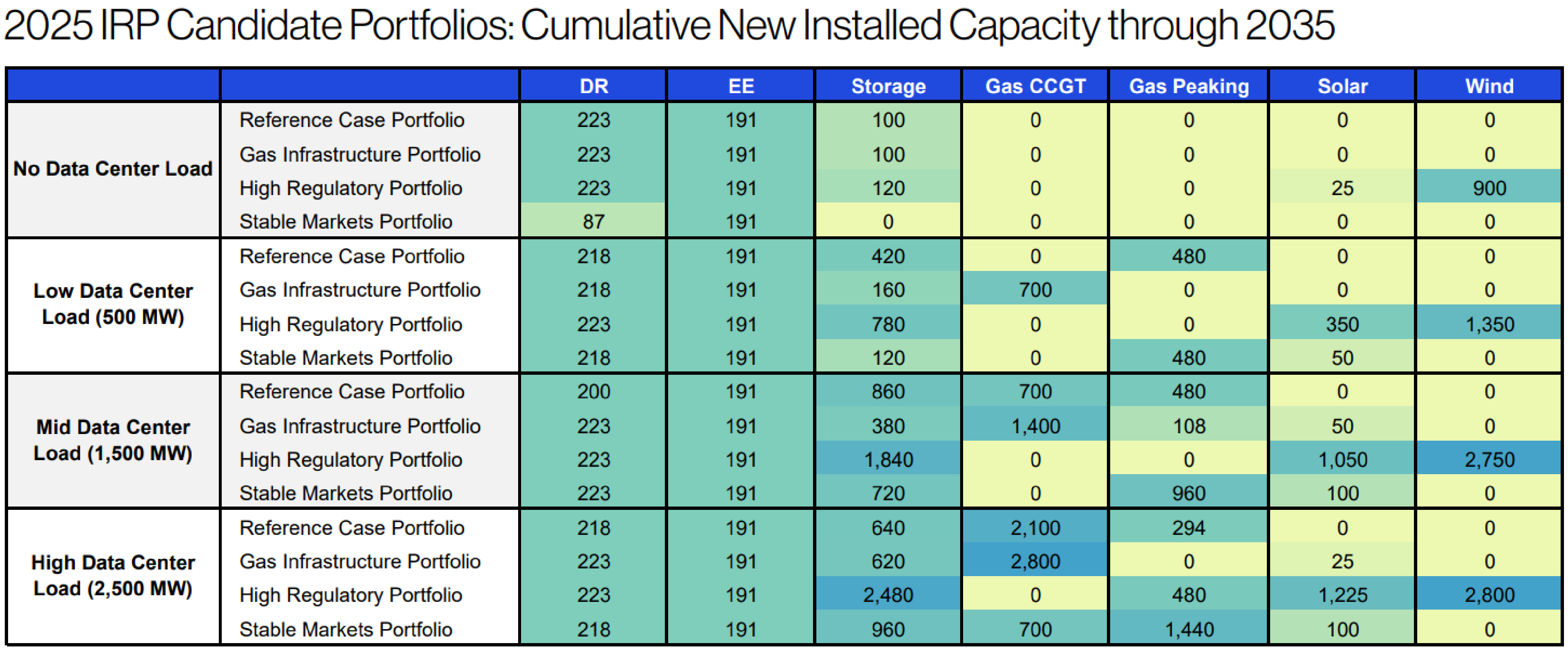
What About Indiana?

- Wabash Valley Power Alliance (WVPA) 2023 IRP



What About Indiana?

- AES Indiana 2025 IRP

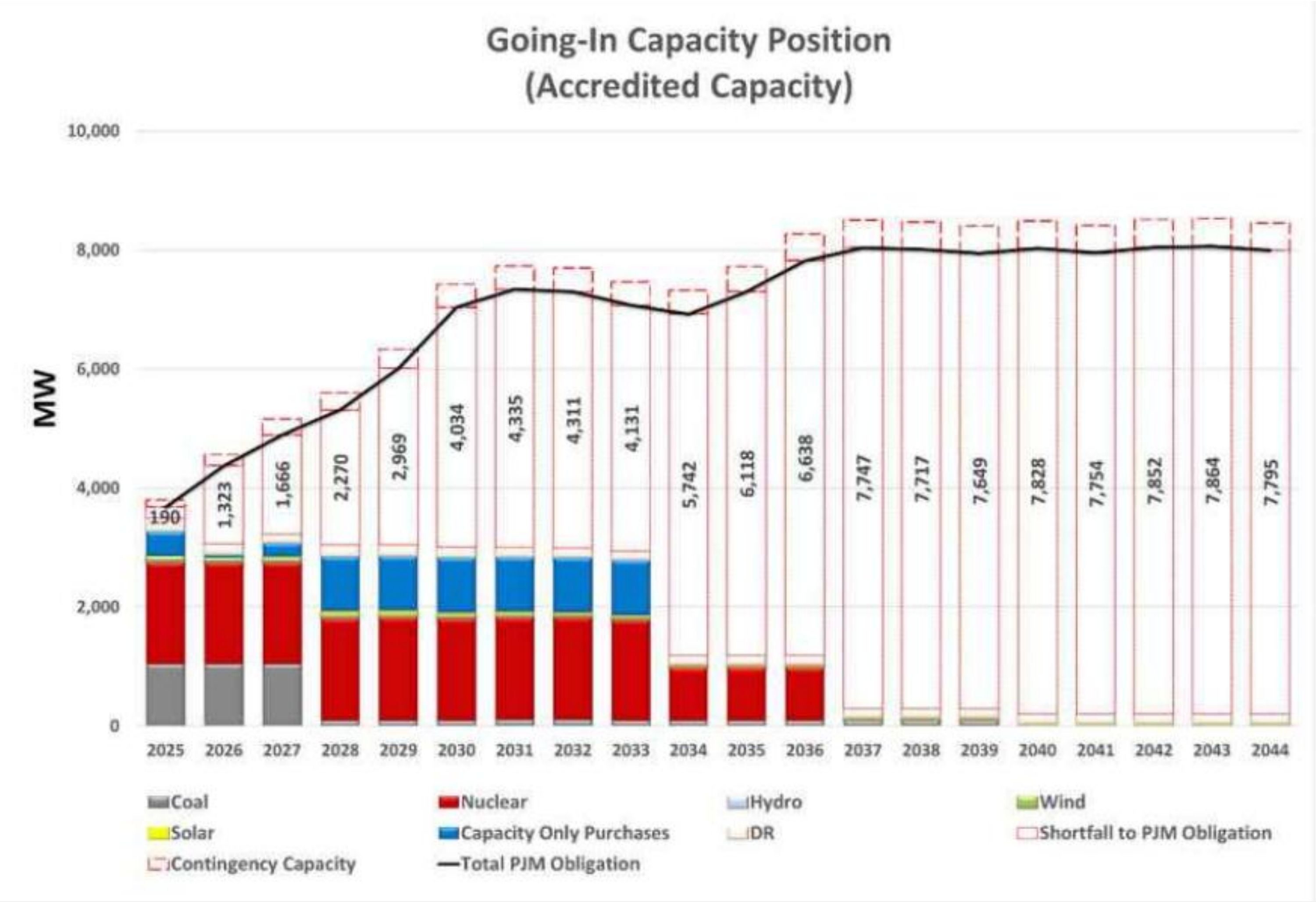


2025 IRP Candidate Portfolios: Cumulative New Installed Capacity through 2035

		DR	EE	Storage	Gas CCGT	Gas Peaking	Solar	Wind
No Data Center Load	Reference Case Portfolio	223	191	100	0	0	0	0
	Gas Infrastructure Portfolio	223	191	100	0	0	0	0
	High Regulatory Portfolio	223	191	120	0	0	25	900
	Stable Markets Portfolio	87	191	0	0	0	0	0
Low Data Center Load (500 MW)	Reference Case Portfolio	218	191	420	0	480	0	0
	Gas Infrastructure Portfolio	218	191	160	700	0	0	0
	High Regulatory Portfolio	223	191	780	0	0	350	1,350
	Stable Markets Portfolio	218	191	120	0	480	50	0
Mid Data Center Load (1,500 MW)	Reference Case Portfolio	200	191	860	700	480	0	0
	Gas Infrastructure Portfolio	223	191	380	1,400	108	50	0
	High Regulatory Portfolio	223	191	1,840	0	0	1,050	2,750
	Stable Markets Portfolio	223	191	720	0	960	100	0
High Data Center Load (2,500 MW)	Reference Case Portfolio	218	191	640	2,100	294	0	0
	Gas Infrastructure Portfolio	223	191	620	2,800	0	25	0
	High Regulatory Portfolio	223	191	2,480	0	480	1,225	2,800
	Stable Markets Portfolio	218	191	960	700	1,440	100	0

What About Indiana?

- Indiana Michigan Power 2024 IRP



What About Indiana?

- Duke Energy Indiana 2024 IRP

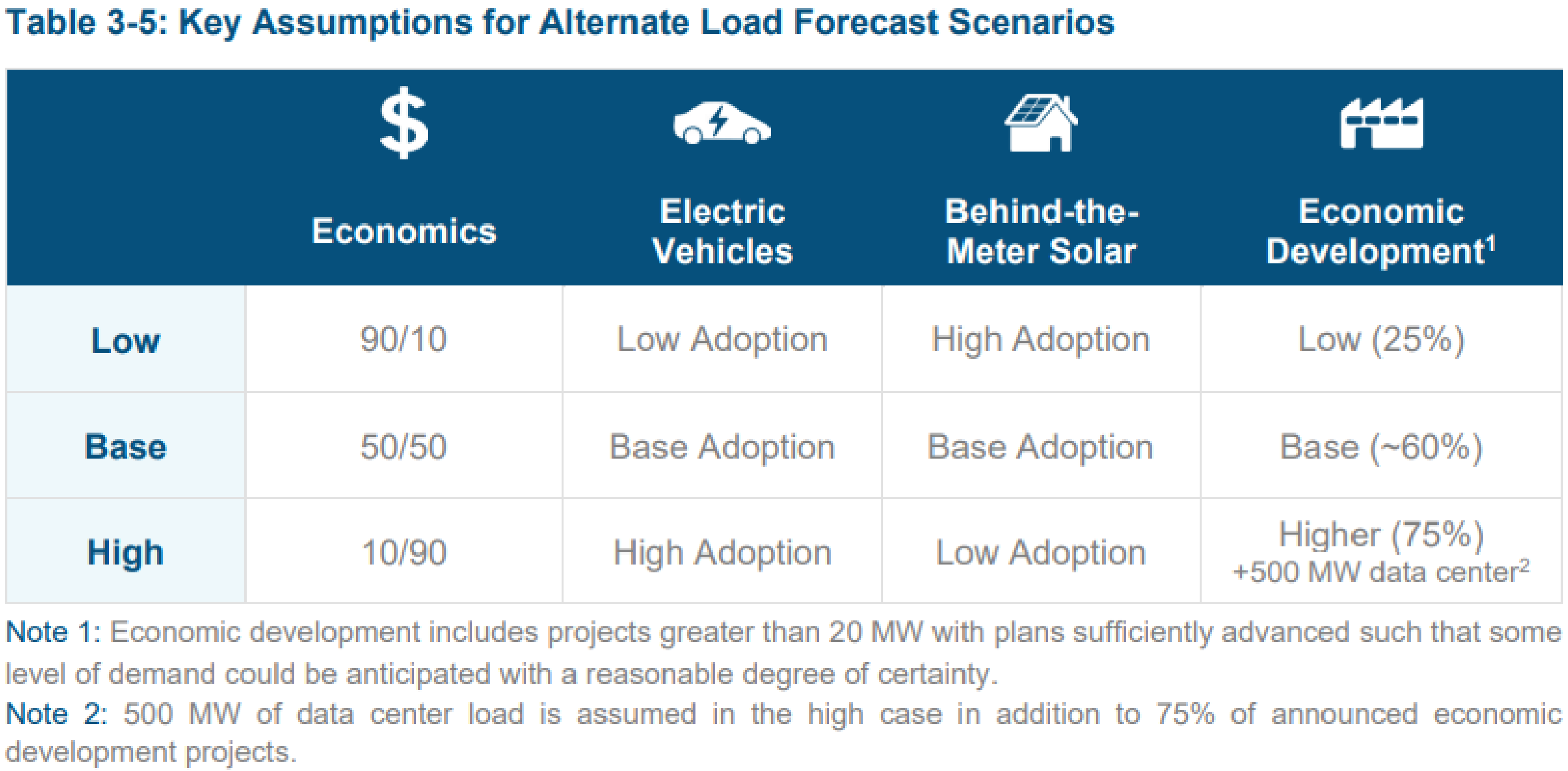


Table 3-5: Key Assumptions for Alternate Load Forecast Scenarios

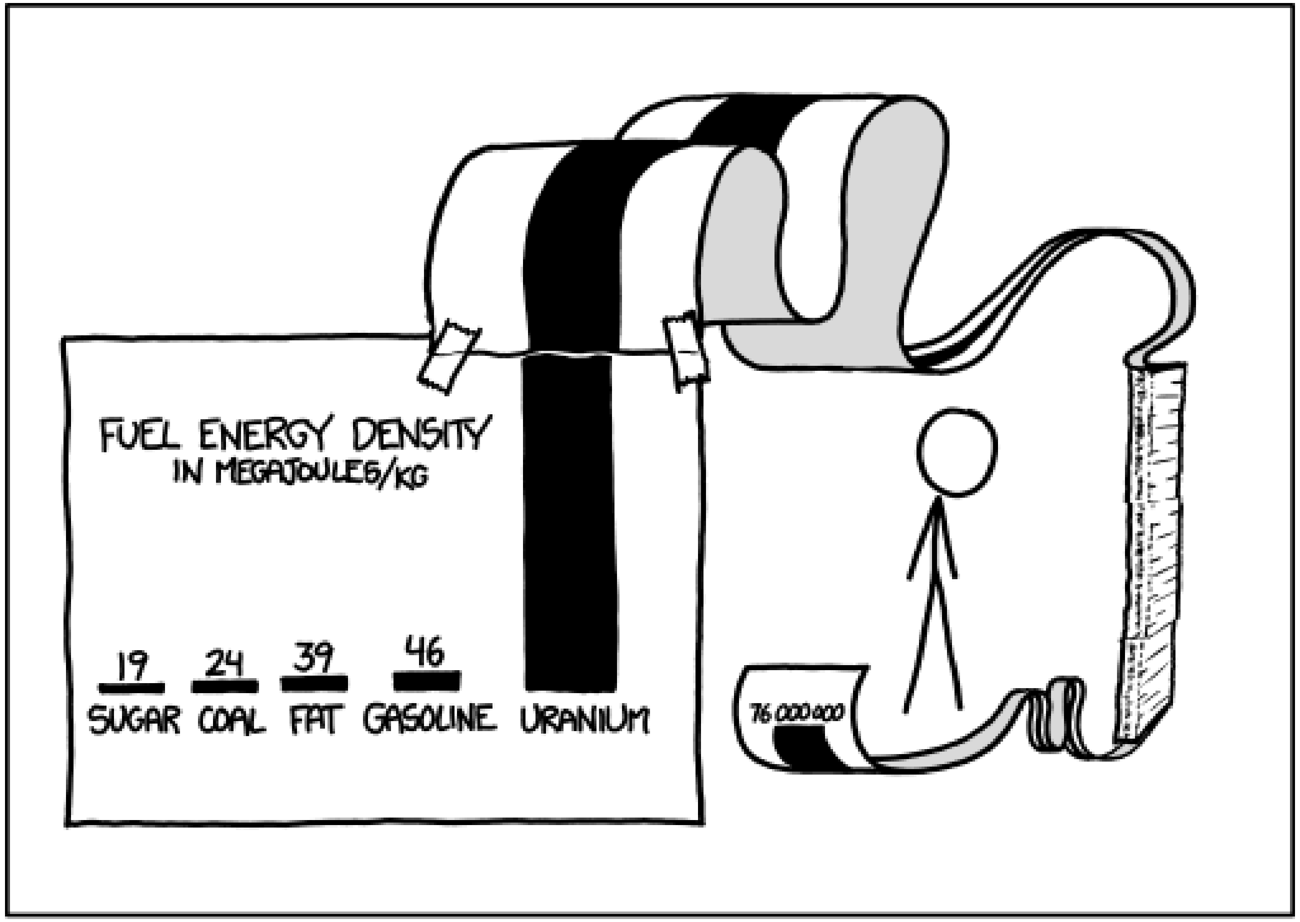
	Economics	Electric Vehicles	Behind-the-Meter Solar	Economic Development[1]
Low	90/10	Low Adoption	High Adoption	Low (25%)
Base	50/50	Base Adoption	Base Adoption	Base (~60%)
High	10/90	High Adoption	Low Adoption	Higher (75%) +500 MW data center[2]

Note 1: Economic development includes projects greater than 20 MW with plans sufficiently advanced such that some level of demand could be anticipated with a reasonable degree of certainty.

Note 2: 500 MW of data center load is assumed in the high case in addition to 75% of announced economic development projects.

NUCLEAR ENERGY IN INDIANA

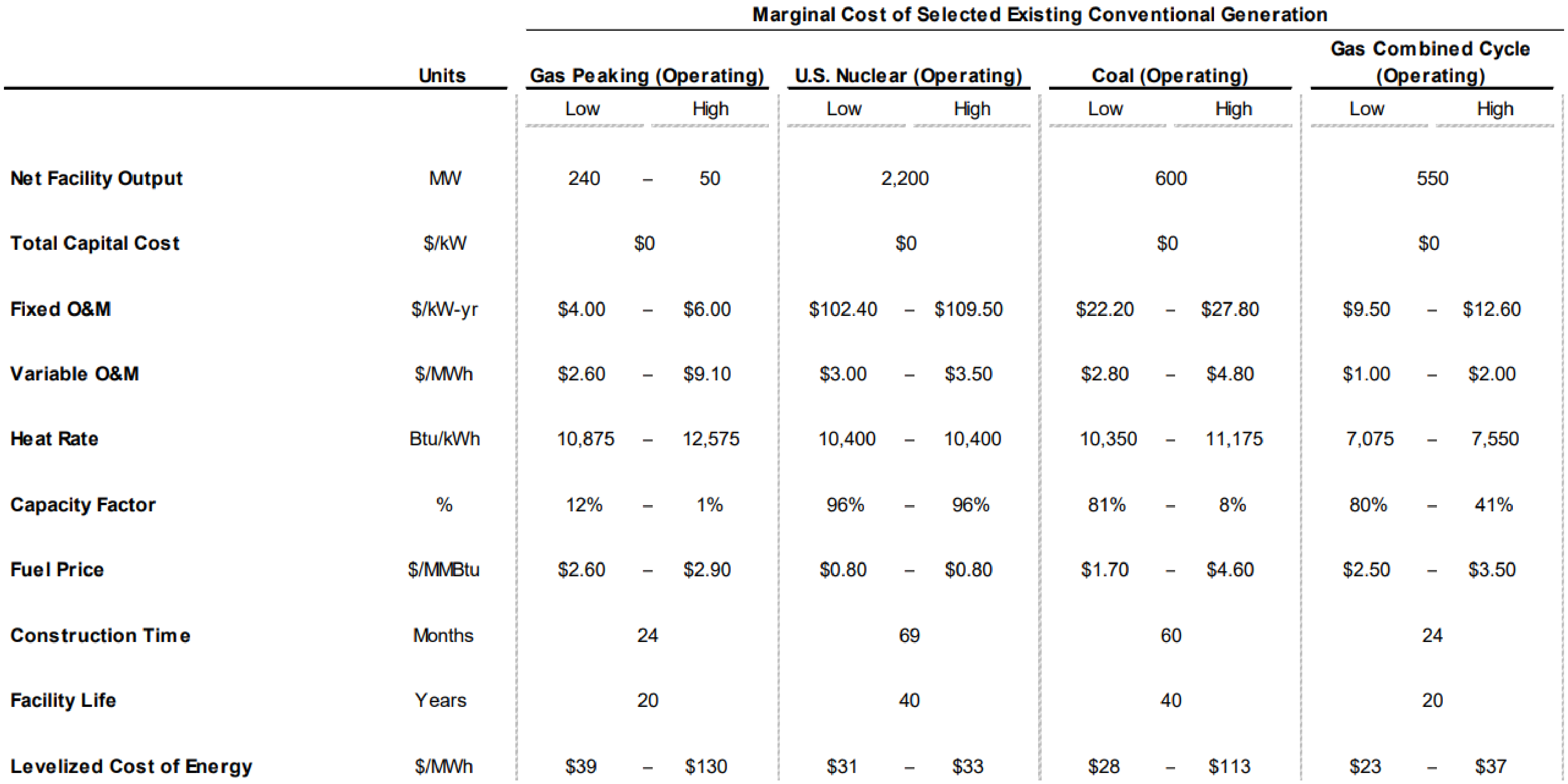
Nuclear Energy



SCIENCE TIP: LOG SCALES ARE FOR QUITTERS WHO CAN'T FIND ENOUGH PAPER TO MAKE THEIR POINT *PROPERLY.*

Source: XKCD

Nuclear Energy

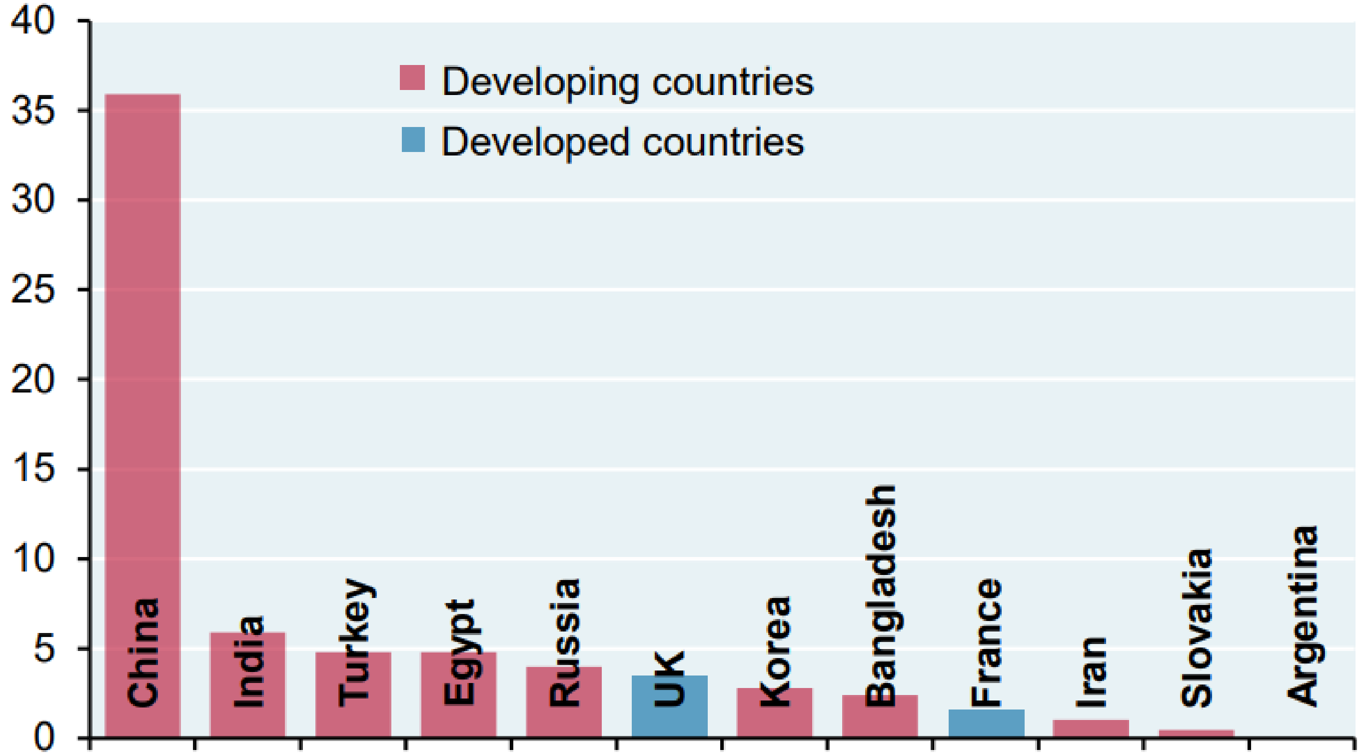


		Marginal Cost of Selected Existing Conventional Generation							
	Units	Gas Peaking (Operating)		U.S. Nuclear (Operating)		Coal (Operating)		Gas Combined Cycle (Operating)	
		Low	High	Low	High	Low	High	Low	High
Net Facility Output	MW	240	50	2,200		600		550	
Total Capital Cost	$/kW	$0		$0		$0		$0	
Fixed O&M	$/kW-yr	$4.00	$6.00	$102.40	$109.50	$22.20	$27.80	$9.50	$12.60
Variable O&M	$/MWh	$2.60	$9.10	$3.00	$3.50	$2.80	$4.80	$1.00	$2.00
Heat Rate	Btu/kWh	10,875	12,575	10,400	10,400	10,350	11,175	7,075	7,550
Capacity Factor	%	12%	1%	96%	96%	81%	8%	80%	41%
Fuel Price	$/MMBtu	$2.60	$2.90	$0.80	$0.80	$1.70	$4.60	$2.50	$3.50
Construction Time	Months	24		69		60		24	
Facility Life	Years	20		40		40		20	
Levelized Cost of Energy	$/MWh	$39	$130	$31	$33	$28	$113	$23	$37

Source: Lazard

Nuclear Energy

Nuclear plants under development with estimated grid connection dates between 2024-2030, GW of capacity



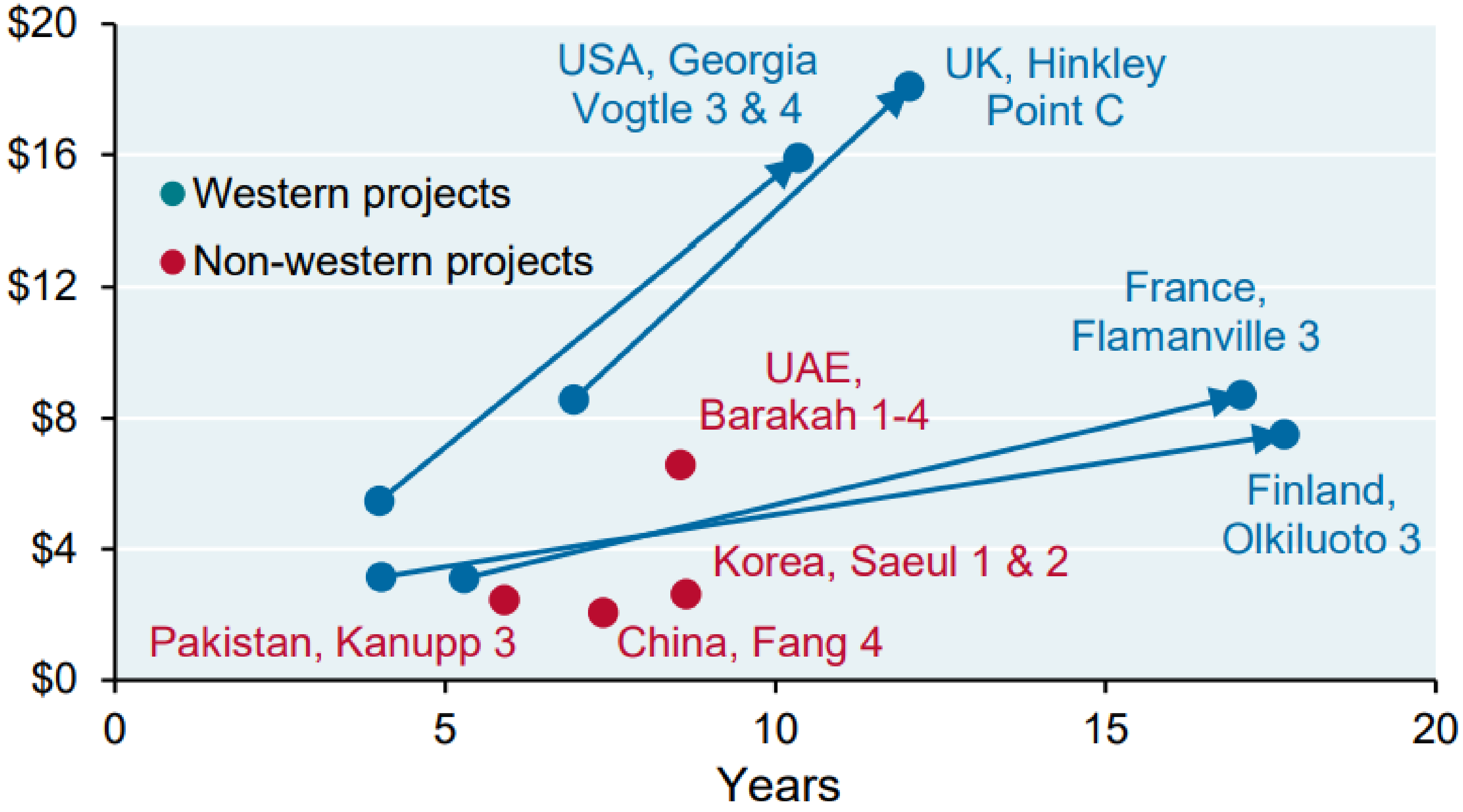
Source: World Nuclear Association, JPMAM, 2024

Source: J.P. Morgan 2025 Annual Energy Paper

Nuclear Energy

Capital cost and construction time of nuclear plants

US$ millions / MW

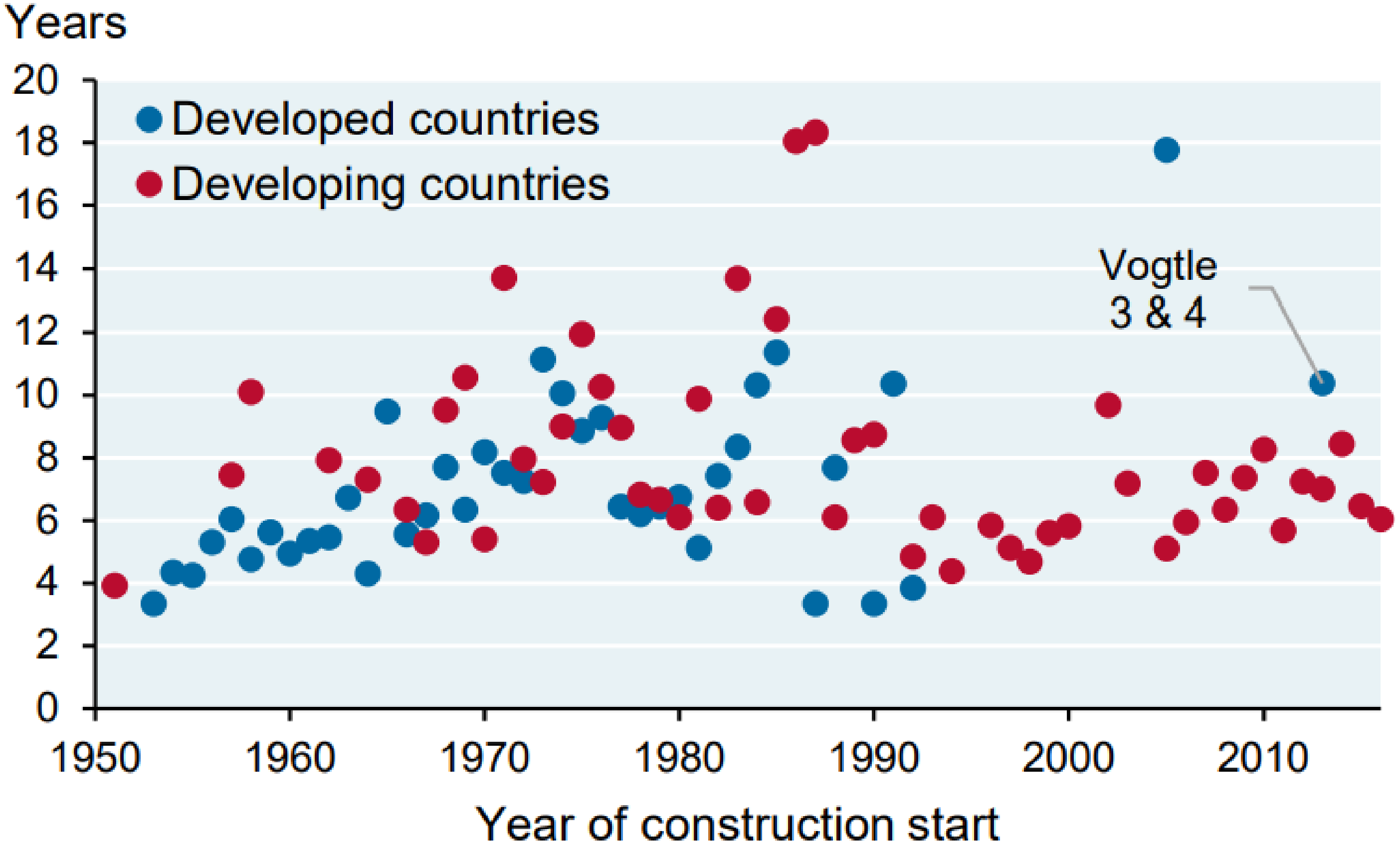


Source: IEA, Power Reactor System Database, JPMAM, February 2025

Source: J.P. Morgan 2025 Annual Energy Paper

Nuclear Energy

Average nuclear plant completion time by year and region

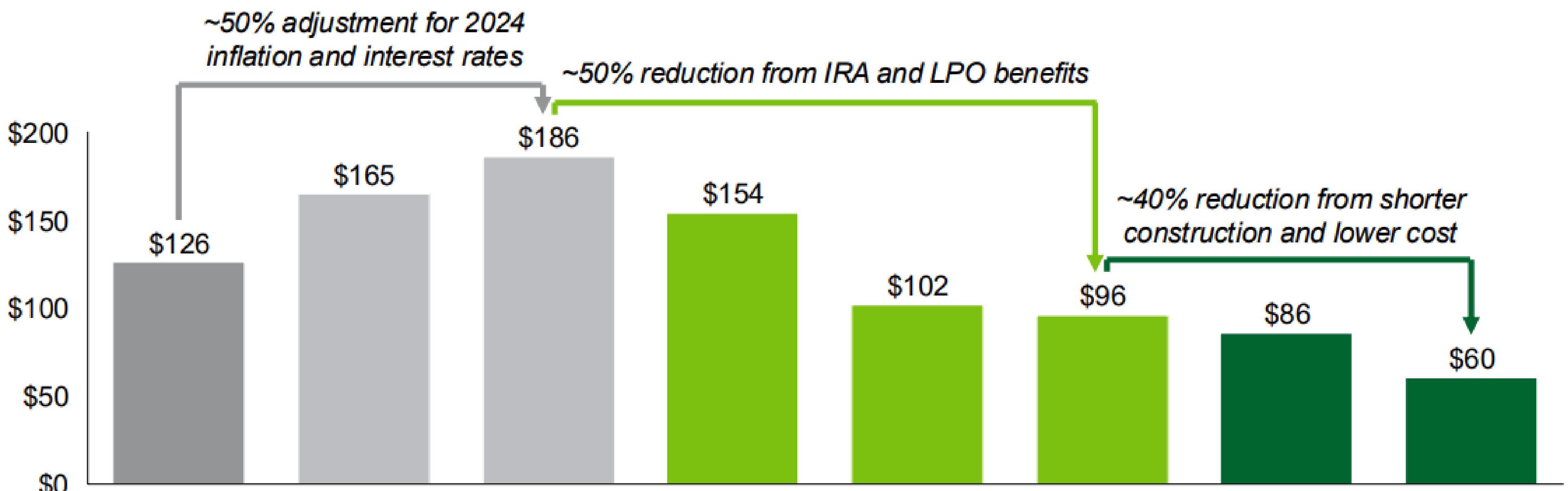


Source: Power Reactor System Database, JPMAM, September 2024

Source: J.P. Morgan 2025 Annual Energy Paper

Nuclear Energy

LCOE using NREL model, 2024 $/MWh



	Vogtle 3+4	Inflation	5% interest rates	80% debt	40% ITC	5 year MACRS	6 year construction	$8,300/kw
vernight capital cost	$11,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$8,300
Construction time	11 years	11 years	11 years	11 years	11 years	11 years	6 years	6 years
Interest rate on debt	3.5%	3.5%	5%	5%	5%	5%	5%	5%
Debt fraction	60%	60%	60%	80%	80%	80%	80%	80%
Tax credit	PTC (old)	PTC (old)	PTC (old)	PTC (old)	40% ITC	40% ITC	40% ITC	40% ITC
Depreciation	15 years	15 years	15 years	15 years	15 years	5 years	5 years	5 years

Source: US DOE Advanced Nuclear Liftoff Report

Recent State Legislative Actions

- Senate Enrolled Act 271-2022
    - Required the IURC to adopt rules for SMR CPCNs and allowed SMR projects to qualify for financial incentives as “clean energy projects” and “nuclear energy production or generating facility”

- Senate Enrolled Act 176-2023
    - Modified the SMR definition to include generation resources up to 470MW (up from 350MW)

Recent State Legislative Actions

- House Enrolled Act 1007-2025
  - Created a state tax credit for manufacturing SMR components in Indiana.

- Senate Enrolled Act 423-2025 & 424-2025
  - Established new adjust rate mechanisms for the timely recover of project development costs associated with an SMR project.
    - This would include costs associated with evaluation, design, and engineering of SMRs as well as costs for federal approval & licensing.
  - SEA 423 implemented a framework for utilities to partner with other stakeholders, such as third-party investors or large load customers, to help provide financial, managerial, or technical assistance with the project.

THANK YOU

INDIANA OFFICE OF ENERGY DEVELOPMENT

Luke Wilson, Chief Policy Officer

2025 DOE National Energy Forecast

INDIANA OFFICE OF ENERGY DEVELOPMENT

Henry Wilhelmus, Electricity Program Manager

11/19/2025

Indiana Office of Energy Development

DOE National Energy Forecast – Summary of July 2025 Resource Adequacy Report

November 19, 2025

Department of Energy (DOE)

- Created this report in collaboration with Pacific Northwest National Laboratory (PNNL) and National Renewable Energy Laboratory (NREL).
- Summarized today by the Indiana Office of Energy Development (OED).

National Context of DOE Report

Executive Order 14262: Directed DOE to establish a uniform reliability methodology.

National Concerns: Retiring generation, surging demand, and rising reliability risks.

2030 scenarios modeled under new methodology to determine regional stability.

DOE used these models to determine readiness of the U.S. grid against future demand.

National Energy Outlook: The DOE’s Take on the Grid

- U.S. has abundant resources (oil, gas, coal, nuclear).
- But: Retirements of dispatchable generation coupled with additions of large loads is creating stress on the system.
- DOE: Considers status quo unsustainable, stresses risk of **100x more** outages by 2030 without intervention.
- Forecast theme: Grid reliability now central to U.S. economic and national security.

Drivers of Demand Growth

- Data centers & AI: Projected 50 GW of new load by 2030.
- Manufacturing & Reindustrialization: Reshoring adds sustained industrial load.
- Electrification of transport and heating shifts additional load growth onto the grid.
- Peak load forecast: +15% (774 GW → 889 GW by 2030).

DOE’s Updated Reliability Standards

- Old Standard: 1-in-10 LOLE (loss of load expectation):
  - 1 day lost in 10 years
- New DOE approach: Factoring in Normalized Unserved Energy
  - Duration: ≤ 2.4 hours lost load per year.
  - Magnitude: ≤ 0.002% of energy unserved (NUSE)
- Why it matters: Accounts for outage severity and scale, not just frequency.

$$\frac{100\ MWh\ (of\ unserved\ energy)}{10{,}000{,}000\ MWh\ (of\ total\ energy\ delivered\ in\ a\ year)} x100 = 0.001\ percent$$

DOE’s Methodology

Modeling Tool: Zonal PLEXOS used for load, generation, and transfer ability.

Time Horizon: 12 years of weather data, (2007 – 2013, 2019 – 2023), modeled through 2030.

Deterministic Approach: Creates hour-by-hour simulation

DOE's Methodology Assumptions

- AI/Data Centers: 50 GW nationally by 2030.
- Storage: Based on NERC IRCS:
  - Pumped hydro assumed to be 12 hours.
  - Battery at 4 hours.
- Imports and Demand Response were modeled only after local resources were exhausted (110% of load demand)
- Solar/Wind/Thermal: Availability is assumed based on historical EIA output data, and NERC assessments.

Generation Outlook

- Retirements: 104 GW by 2030 (71 GW of coal, 25 GW of gas).
- Additions: 209 GW planned, but only 22 GW firm.
- Net effect: Growing mismatch between firm capacity and peak demand.
- DOE hypothesis: If plant closures occur, outages will rise

DOE’s 2030 Test Scenarios

Plant Closures: All announced retirements + Tier 1 additions

No Plant Closures: Retirements deferred past 2030 + Tier 1 additions proceed

Required Build: Perfect capacity added until reliability restored

DOE stress-tested all with 12 historic weather years

Tier 1 additions refer to Tier 1 of the 2024 NERC LTRA Additions Report

National Case Review: Plant Closures

- Annual outages hours (LOLH): increase from **8** hrs. to as high as **817** hrs.
- Worst year: 1,316 hours lost (≈55 days)
- NUSE: 0.046% vs the 0.002% threshold
- Widespread reliability shortfalls, only ISO-NE and NYISO remain within limits

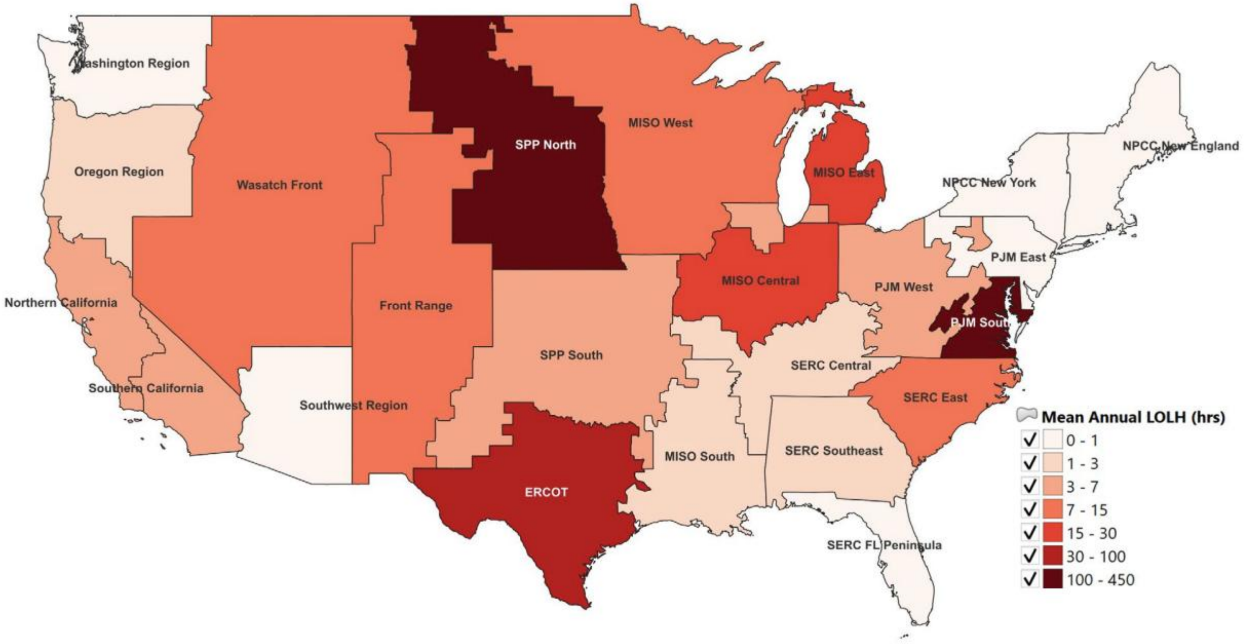


Figure 1. Mean Annual LOLH by Region (2030) – Plant Closures

National Case Review: No Plant Closures

Improves reliability, but not enough:

- PJM: 214 hours/year lost, 0.066% NUSE
- SPP & ERCOT: still facing outages despite improvements

Deferring retirements helps, but can't close the reliability gap nationwide

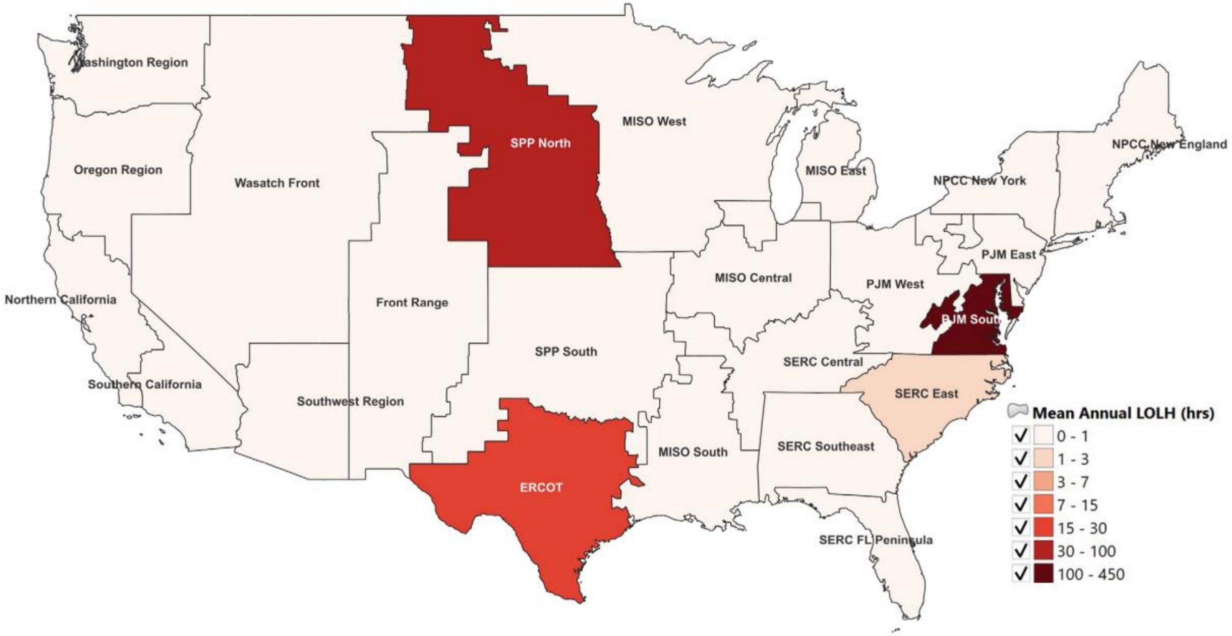


Figure 2. Mean Annual LOLH by Region (2030) – No Plant Closures

Required Build Analysis

Needed by 2030:

PJM → 10.5 GW

ERCOT → 10.5 GW

SERC-East → 0.5 GW

SPP → 1.5 GW

≈23 GW of firm capacity needed beyond current plans assuming no plant closures.

Regional Forecast: MISO

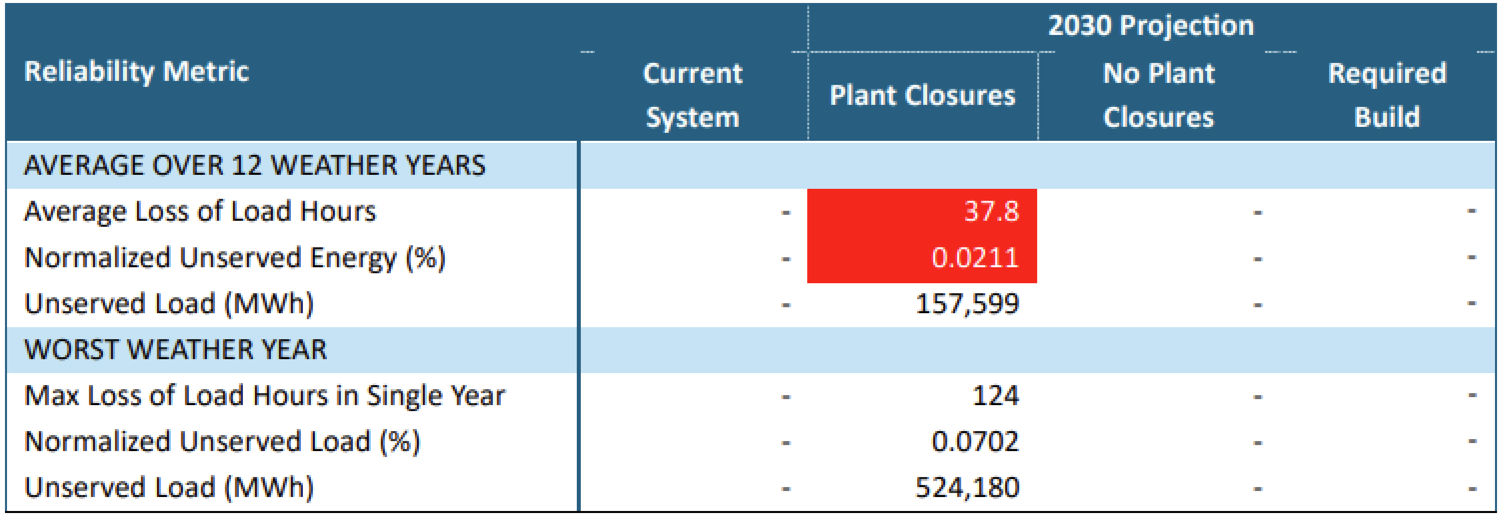
+10 GW load by 2030 (6 GW from data centers)

Mostly stable in No Closures case, but increasingly import-dependent by 2030

Closures Case forecasts 124 outage hours in worst year, 0.07% NUSE

Overall: Rising import reliance noted as increasing exposure

Table 2. Summary of MISO Reliability Metrics



Reliability Metric	Current System	2030 Projection		
		Plant Closures	No Plant Closures	Required Build
AVERAGE OVER 12 WEATHER YEARS				
Average Loss of Load Hours	-	37.8	-	-
Normalized Unserved Energy (%)	-	0.0211	-	-
Unserved Load (MWh)	-	157,599	-	-
WORST WEATHER YEAR				
Max Loss of Load Hours in Single Year	-	124	-	-
Normalized Unserved Load (%)	-	0.0702	-	-
Unserved Load (MWh)	-	524,180	-	-

Regional Forecast: PJM

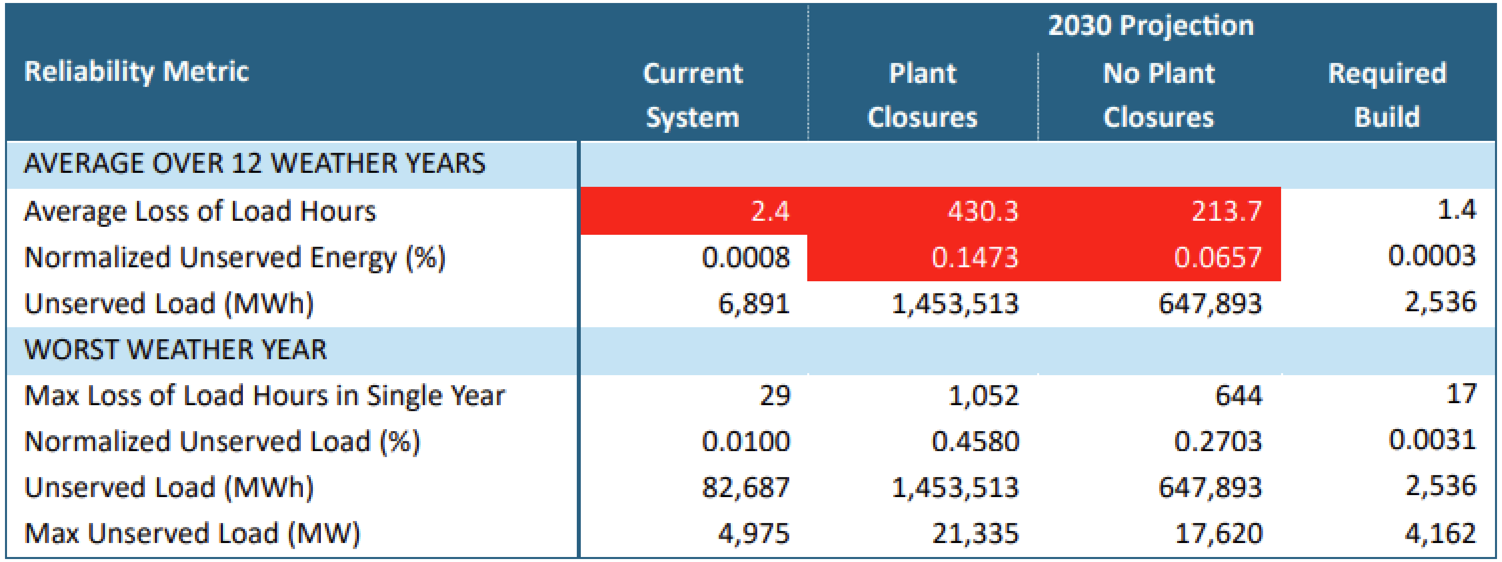
+25 GW load by 2030 (15 GW from data centers)

Modeled at weakest nationwide reliability outlook.

430 outage hours/yr in Closures Case, 1052 in worst year.

Overall: 70x above new DOE threshold assuming planned retirements.

Table 8. Summary of PJM Reliability Metrics



Reliability Metric	Current System	2030 Projection		
		Plant Closures	No Plant Closures	Required Build
AVERAGE OVER 12 WEATHER YEARS				
Average Loss of Load Hours	2.4	430.3	213.7	1.4
Normalized Unserved Energy (%)	0.0008	0.1473	0.0657	0.0003
Unserved Load (MWh)	6,891	1,453,513	647,893	2,536
WORST WEATHER YEAR				
Max Loss of Load Hours in Single Year	29	1,052	644	17
Normalized Unserved Load (%)	0.0100	0.4580	0.2703	0.0031
Unserved Load (MWh)	82,687	1,453,513	647,893	2,536
Max Unserved Load (MW)	4,975	21,335	17,620	4,162

Policy Forecast (DOE Suggestions)

Avoid	Premature retirements of firm generation
Accelerate	Firm capacity additions to the grid
Strengthen	Interregional transfer ability

The DOE Energy Forecast for 2030

Current 2030 forecast shows:

- Demand growth will outpace firm supply
- Reliability shortfalls across most regions with planned retirements.
- National security and the international AI/data center race at stake

Key Takeaways:

- Status quo is unsustainable
- Grid growth must match pace of AI innovation
- Retirements plus load growth increase risk of lost load by 100x in 2030
- Planned supply falls short, reliability is at risk

Indiana's Action in the AI Race

Executive Action on Nuclear Development

Governor Braun issued relevant Executive Orders:

- E.O. 25-48 creating Nuclear Indiana Coalition
- E.O. 25-49 included nuclear as option for practical climate solution
- E.O. 25-66 created an Energy Task Force to investigate Indiana's energy options

Nuclear investment within the State of Indiana:

First American Nuclear (FANCO) to move HQ to IN in $4B+ investment

AES launched a feasibility study on SMR deployment at Petersburg Site

AEP continues review of Rockport SMR conversion

Closing

- DOE frames their report as a national call to action.
    - Defer retirements
    - Increase capacity
    - Realize that a simple acceleration of current plans is insufficient.

- Indiana is well positioned through past legislative and regulatory planning to meet this moment.

Thank you

Henry K. Wilhelmus

SMR Study Overview

Dr. Seungjin Kim

11/19/2025

SMALL MODULAR REACTOR (SMR)

By

Seungjin Kim

Engineering Leadership Team Meeting

May 5, 2022

HISTORY OF NUCLEAR ENERGY

GENERATION I

Experimental reactors (Fermi, Magnox)

Shippingport, PA (PWR,’ 57)

Dresden, IL (BWR, ‘59)

1st prototype nuclear power reactors

GENERATION II

Commercial Power Reactors

LWR: PWR, BWR

HWR: CANDU

HTGR / AGR

VVER / RBMK

most of the currently running commercial nuclear reactors

GENERATION III & III$^+$

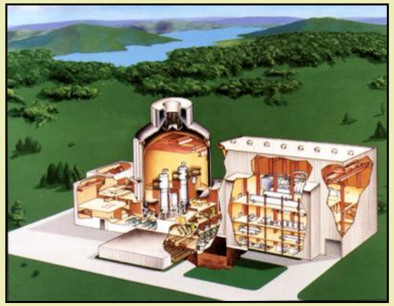
Evolutionary Advanced Power Reactors

Passive Safety Features

Better Economics

SBWR, APWR, EPR

ESBWR, ACR



being licensed and built

GENERATION IV

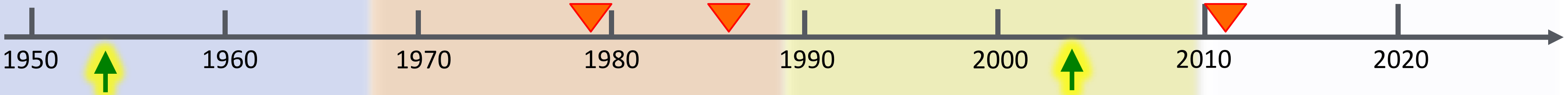
Next Generation Power Reactors by 2030

Economical; Safe;

Sustainable;

Proliferation Resistant

being developed to be deployed by 2030



TMI (1979)

Chernobyl (1986)

Fukushima (2011)

Atoms for Peace (1953)

Generation IV Roadmap (2002)

SMR DESIGN CONCEPTS

- Small in Power and Size.
  - ✓ Conventional nuclear power reactor produces more than 1,000 MWe (up to 1,600 MWe).
  - ✓ SMR is designed to produce ~350 MWe or less.
- Modular in Design, Production, and Deployment.
  - ✓ Integral; Factory-assembled; Transportable; Deployable.
- Enhanced Safety.

⇨ Envisaged to be readily installed in brownfield sites in place of decommissioned fossil fuel plants

SMR DESIGN FEATURES

- Smaller Core Inventory ⇨ Flexibility in Siting.
- Simple Single-vessel Integrated Design.
  - ✓ Substantially increase heat capacity and thermal inertia ⇨ Provides indefinite ‘coping’ time.
  - ✓ Less failure modes ⇨ Less reliance on ‘active’ safety systems including pumps and AC power.
  - ✓ Significant reduction in O&M costs.
- Modularization ⇨ Enhanced Quality Control & Reduction in Construction Risks.

SMR DESIGN FEATURES

- Enhanced Safety Systems.
  - ✓ 'Passive' safety systems ⇨ Driven by gravity, pressure difference, natural circulation (*'Walk-away safe*').
  - ✓ Below-grade Installation ⇨ Enhanced protection from natural and external hazards.
- Less Capital Cost ⇨ Cheaper Electricity Cost.
- Smaller Foot-print.⇨ Flexible in Siting.
- Load-following & Nuclear-Hybrid Systems.
  - ✓ Hydrogen generation, desalination, complement other renewables, energy storage

SMR PROSPECTIVE

(As of Dec. 2021)

- SMRs in Operation (11 MWe ~ 300 MWe):

  China, India, Pakistan, Russia.

- Near-term Deployment in the US (35 MWe ~ 345 MWe):

  NuScale-Fluor (water); Holtech (water); GE-Hitachi (water); RR (water); Terra Power+GE-Hitachi (sodium); Arc+GE-Hitachi (sodium); Kairos (molten salt); X-energy (helium).

- DOE ARDP recently announced plans for 2030 deploy/operation in the US.

SMR TECHNOLOGY AND ITS IMPACT FOR INDIANA

PURDUE UNIVERSITY®

150 YEARS OF PURDUE ENGINEERING

INDIANA OFFICE OF ENERGY DEVELOPMENT

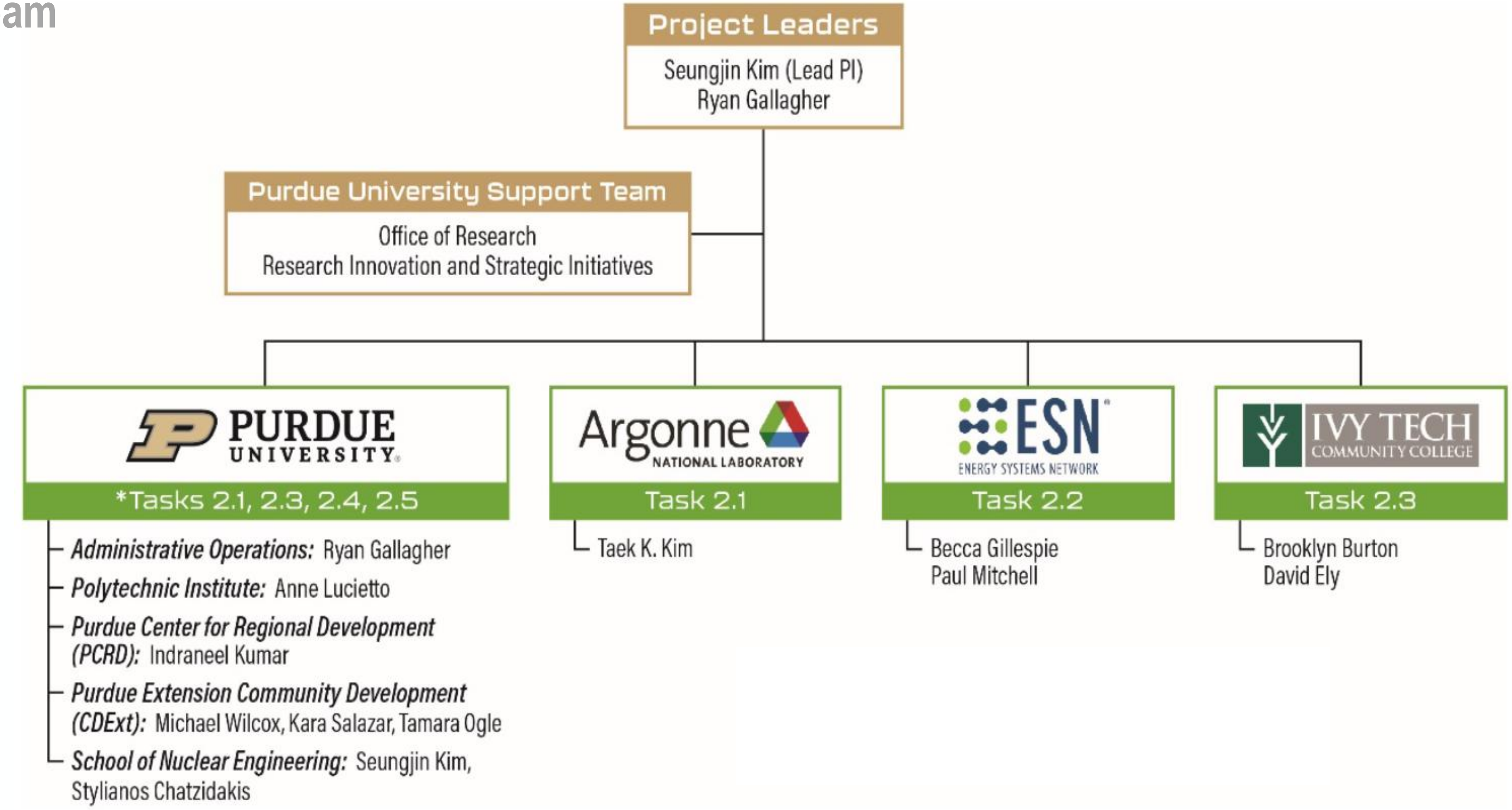
SMR Technology and Its Impact for Indiana

Study Goal

- To perform a comprehensive study that analyzes SMR technology applications and their impacts.
- To assist IOED in the development of a comprehensive energy transition plan and policies that benefit Indiana.

SMR Technology and Its Impact for Indiana

Study Team



Project Leaders

Seungjin Kim (Lead PI)
Ryan Gallagher

Purdue University Support Team

Office of Research
Research Innovation and Strategic Initiatives

Purdue University – *Tasks 2.1, 2.3, 2.4, 2.5
- *Administrative Operations:* Ryan Gallagher
- *Polytechnic Institute:* Anne Lucietto
- *Purdue Center for Regional Development (PCRD):* Indraneel Kumar
- *Purdue Extension Community Development (CDExt):* Michael Wilcox, Kara Salazar, Tamara Ogle
- *School of Nuclear Engineering:* Seungjin Kim, Stylianos Chatzidakis

Argonne National Laboratory – Task 2.1
- Taek K. Kim

ESN Energy Systems Network – Task 2.2
- Becca Gillespie
- Paul Mitchell

Ivy Tech Community College – Task 2.3
- Brooklyn Burton
- David Ely

SMR Technology and Its Impact for Indiana

Conclusion and Key Recommendations

Conclusion

SMRs present a **viable opportunity** for Indiana to transition to a **cleaner, resilient and diversified energy future.**

Successful deployment of SMR technology requires a **careful balance** of economic, regulatory and social considerations along with development of the technology.

Key Recommendations

The state of Indiana, as well as Indiana energy stakeholders, should **proceed with feasibility studies, build partnerships** for SMR development and **prioritize stakeholder engagement** to ensure SMRs are integrated smoothly and beneficially into the state's energy portfolio. More specific recommendations include:

- **Develop educational resources** for differing audiences to build on publicly understood benefits of nuclear energy while educating on perceived safety and environmental concerns.
- **Review existing state requirements, investigate incentives** and **lead in technology standardization** with a goal of de-risking SMR construction within the state, especially at existing or retired coal plants.
- **Take advantage of existing supply chain resources** within the state to ensure Indiana's economy benefits from SMR construction anywhere in the nation.

SMR Technology and Its Impact for Indiana

Opportunities & Challenges

OPPORTUNITIES

- **LEADERSHIP ROLE IN SUPPLY CHAIN AND MANUFACTURING ECOSYSTEMS**. Early adopters could craft workforce development and supply chain programs, incentivizing new, high-value business opportunities to locate in Indiana
- **LOCAL EXPENDITURES**. Many material and labor expenditures are sourced locally
- **COAL-TO-NUCLEAR TRANSITION**. Existing or retired coal plant sites and their workforce could be repurposed to support nuclear energy

CHALLENGES

- **FIRST-OF-A-KIND (FOAK) CONSTRUCTION COSTS**. Subsequent “nth-of-a-kind” (NOAK) units are expected to be significantly cheaper as experience and efficiencies improve
- **SUPPLY CHAIN STABILITY**. High-cost components like reactor vessels require reliable supply networks
- **NAVIGATING FEDERAL AND STATE REGULATORY FRAMEWORKS**. Careful planning will be required to meet stringent safety and environmental standards
- **WASTE HANDLING AT FEDERAL LEVEL.** Resume the discussion on establishing a national deep geological repository as well as nuclear fuel recycling

OPPORTUNITIES FOR INDIANA

- Coal-to-nuclear transition
- 24/7 dispatchable source of carbon free electricity with capacity factor of more than 92%
- Creation of high-paying jobs during construction and operation
- Increase of the tax base
- Increase employment by supply chain providers

SMR Technology and Its Impact for Indiana

Opportunities & Challenges

SMR deployment could stimulate job growth in related industries

Per the *Department of Energy Liftoff Report*:

- First-of-a-kind cost of $6,200/kW is possible, which is 60% of the cost of the most recently constructed U.S. nuclear plant
- Significant opportunities for savings between the FOAK and the NOAK that could reduce costs by another 40%
- Repurposing coal sites could reduce SMR project costs by 7-26% due to existing infrastructure

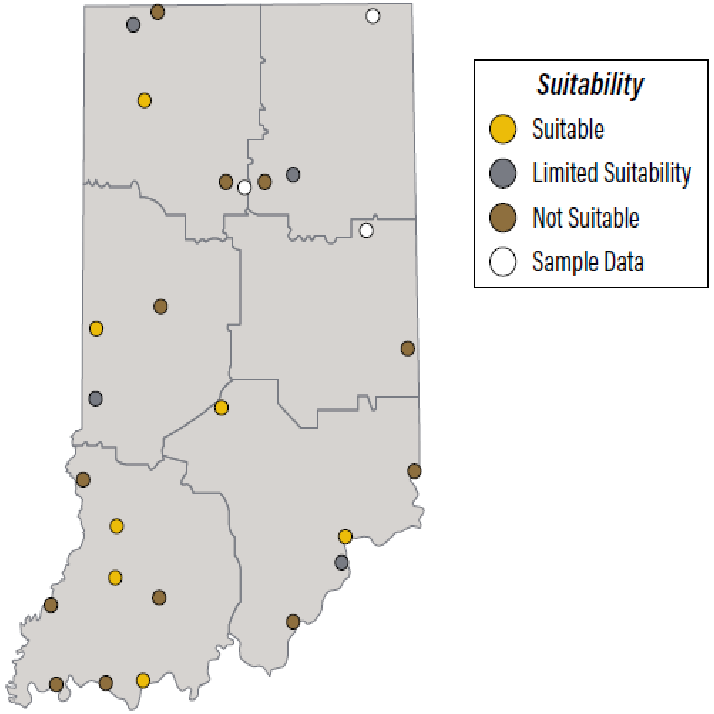
FOUR YEAR CONSTRUCTION PHASE		OPERATIONAL PHASE	
2,000	$500M+	140	$352M
DIRECT JOBS	ANNUAL **ECONOMIC** IMPACT	**FULL-TIME** WORKERS	**ANNUAL ECONOMIC IMPACT**
		Earning 18% more on average than those in coal plants	*Double that of a similarly sized coal plant*

SMR Technology and Its Impact for Indiana

Coal-to-Nuclear (C2N) and Workforce Development

- Key benefits cited by the DOE for C2N included :
  - – **Mitigate the economic impacts** of closing a coal plant
  - – **Minimizing environmental impacts**
  - – **Offer opportunities for existing workforce**
  - – **Leverages existing infrastructure**:
- **Eight** potential C2N sites available in Indiana.
- Purdue in great position to deliver **comprehensive nuclear training**
- Synergy between and within:
  - ○ Purdue Nuclear Engineering as well as other engineering discipline
  - ○ Ivy Tech Community College
  - ○ Other relevant institutions & disciplines

THE COSTS OF OPERATING *a nuclear power plant tend to be about half of the operating costs of a gas turbine plant or coal plant of the same size.*



Thank You!

Purdue Engineering Communications https://engineering.purdue.edu/150

NASEO First Movers Initiative

INDIANA OFFICE OF ENERGY DEVELOPMENT
Jon Ford, Executive Director

11/19/2025