



# What Would It Take? Pathways to 400 GW of U.S. Nuclear Capacity

AI/Data Center Demands and Advanced Nuclear Technologies

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2026  
KL SPECIAL ANALYSIS



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*The OL25-NEMS model used in this analysis is OnLocation's modified version of the U.S. Energy Information Administration's National Energy Modeling System (EIA NEMS). The OL25-NEMS model and results presented here do not represent the views of EIA. OL25-NEMS is based on the EIA Annual Energy Outlook (AEO) 2025 and includes the same market and technology assumptions unless otherwise noted. For more information about EIA NEMS, visit <https://www.eia.gov/outlooks/aeo/>.*

# ANALYSIS OUTLINE

- **Introduction and Highlights**
- **Revitalization of Nuclear Power**
- **Scenario Assumptions and Results**
  - **AI & Data Center Energy Demand**
  - **Electric Sector Response**
  - **Role of Advanced Nuclear Technologies**
- **Further Research Opportunities**
- **Analysis Caveats and Acknowledgements**





# INTRODUCTION AND HIGHLIGHTS



# WHO WE ARE

## KeyLogic



**Innovative company** offering deep domain expertise in our country's most critical undertakings within the energy, federal civilian, and defense sectors. KeyLogic is a subsidiary of System One, Inc.

### Innovative Integration

**Large-scale data management**, advanced analytics, enterprise transformation, science & technology advisory services, R&D management, and systems engineering

### Thought Leaders in Emerging Technologies

**Technology readiness scale** with experience modeling and assessing a range of energy-relevant technologies at low-technology-readiness levels

### Critical Materials Expertise

**Material and resource analysis**, including life-cycle analyses, across the critical materials supply chain in support of energy production, generation, and storage technologies



## OnLocation

**Specialized division of KeyLogic** with more than four decades of experience developing and applying innovative energy system and economic models to address key energy and environmental challenges

### Assess Role of New Energy Technologies

**Evaluate system and economic impacts** of new and emerging energy technologies such as electric vehicles, battery storage, advanced nuclear, biofuels, hydrogen, and carbon capture & storage

### Explore Alternative Energy Futures

**Design "what-if" scenarios** and alternative energy futures for use in uncertainty analyses including alternative energy prices, technology costs, and data center demand projections

### Inform Energy & Environmental Policy

**Perform economic impact assessments** of new or proposed energy and environmental regulations and policies such as the OBBBA, Presidential Executive Orders, and state/local policies

## Points of Contact

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# MOTIVATION FOR ANALYSIS

**U.S. Electricity Demand** has been flat for two decades but is projected to grow due to AI, data centers, and electrification.

**Nuclear Power** can provide firm and reliable generation yet only three units have come online in the last two decades.

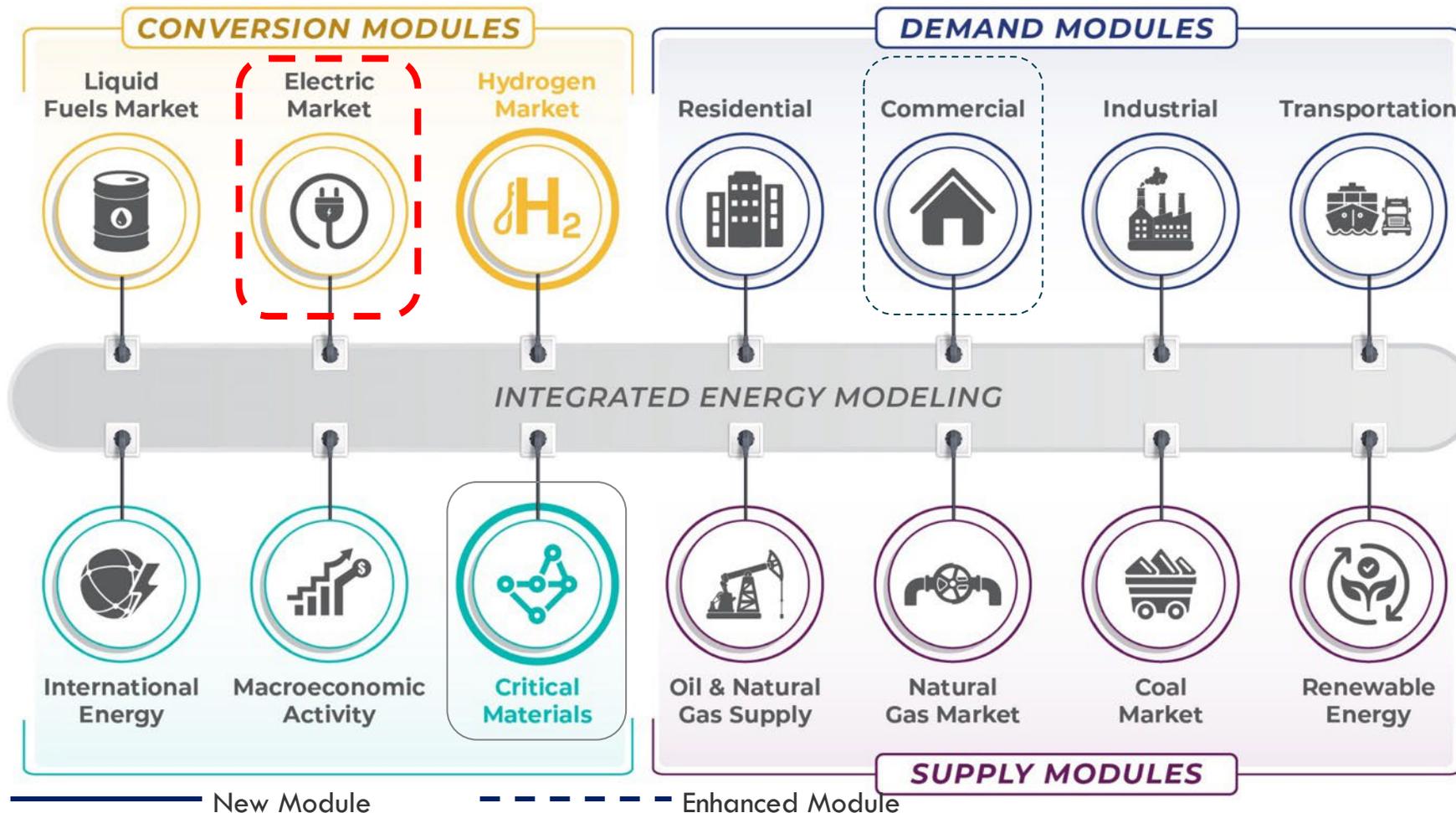
**The Trump Administration** is focused on expanding the role of nuclear power and strengthening the U.S. electricity grid.

**Digital & IT Companies** are making significant investments in nuclear power to meet the energy needs of AI/Data Centers

## **This analysis will:**

- **Evaluate** key driving forces in the U.S. energy system, principally AI & data center energy demand & industry and government responses
- **Assess** the potential role of nuclear power to meet energy demand via a range of advanced technologies
- **Offer** strategic insights on the development of the power system's response, the contribution of nuclear power vs. other technologies, and the role of policy incentives

# CUSTOMIZED VERSION OF THE NATIONAL ENERGY MODELING SYSTEM (OL25-NEMS)



## Development & Application of Energy System Models

- Analyzing Impacts of Demand Growth
- Assessing New Energy Technologies
- Informing Cost-effective Approaches and Policies

## Customization & Analyses

- Regional Data Centers
- Updated Policies
- Advanced Technologies
- Critical Materials

# NUCLEAR POWER ANALYSIS HIGHLIGHTS



Entergy Corporation

**The U.S. has built** only three nuclear units (3.35 GW) in the last three decades due to regulatory complexity, economic inefficiencies, loss of nuclear know-how, and lack of policy support.

**Electricity demand for AI/data centers**, by our analyses, could increase by 5 to 10 times by 2035 to over 15 times by 2050.

**Trump Administration** aims to boost and accelerate nuclear power deployment for national security, to reinvigorate the nuclear industrial base, and to support AI and Data Center growth. Target of 10 large reactors under construction by 2030 and 300 additional GW by 2050.

**Information and technology sector** has made major investments and commitments, at least \$20B to date, for large and small reactors to meet the energy demand for AI/Data Centers.

**Our analysis shows** ~200 GW new large reactors and ~100 SMRs can be achieved via initial policy incentives and industry commitments PLUS additional incentives as a *Nuclear Power Premium* of between \$69 to \$99 Billion annual average thru 2050 (real 2024 USD).

**Major reforms, structural changes, and a sustained national commitment** will be required to deploy advanced nuclear power, establish a dedicated workforce, and address supply chain challenges.



# REVITALIZATION OF NUCLEAR POWER



# TRUMP ADMINISTRATION ACTIONS TO REINVIGORATE NUCLEAR POWER

The WHITE HOUSE



▣ PRESIDENTIAL ACTIONS

## REINVIGORATING THE NUCLEAR INDUSTRIAL BASE

### Key Executive Orders in this Administration

- ❖ Accelerate Development and Deployment of Advanced Nuclear Reactor Technologies for National Security
- ❖ Reform the Nuclear Regulatory Commission
- ❖ Reinvigorate the Nuclear Industrial Base
- ❖ Streamline Nuclear Reactor Testing at the Department of Energy

### Objectives & Planned Outcomes

- ❖ Add 300 Gigawatts (GW) of New U.S. Nuclear Capacity by 2050
- ❖ Facilitate 5 GW of uprates of existing reactors and start construction of ~10 new large reactors by 2030
- ❖ Streamline New Reactor Testing and Commercial Licensing
- ❖ Deploy U.S. Reactors for AI and Military Bases on Federal Land
- ❖ Expand Domestic Nuclear Fuel Production
- ❖ Strengthen the American Nuclear Workforce



- ❖ **Google** has made deals with nuclear developers and utilities to deploy about 500 MW of nuclear capacity by 2035
- ❖ **Microsoft** commitment to purchase energy from nuclear power plants — 20-year PPA with Constellation to restart Three Mile Island, now the Crane Clean Energy Center
- ❖ **Amazon** (AWS) financing (\$500M for X-Energy) and additional investments for nuclear capacity with utilities and developers
- ❖ **META** agreements with Vistra, TerraPower, and Oklo for fuel and reactors
- ❖ Trump Administration partnership with **Brookfield Asset Management** and Cameco to build at least \$80B of new, large-scale nuclear reactors with Westinghouse Electric Company



# DEVELOPMENT OF SCENARIOS



# SCENARIOS AND ASSUMPTIONS

- OnLocation’s version of **National Energy Modeling System (OL25-NEMS)** is based on the official **Annual Energy Outlook (AEO) 2025**, published by the Energy Information Administration, which includes laws and regulations as of December 2024.
- The following updates, assumptions, and targets were applied to develop two scenarios:
  - **Reference Scenario (OL Ref):** Includes policy updates, high data center growth, and updated technology costs
  - **Nuclear Scenario (OL Nuc):** Applies a nuclear power premium to achieve the Administration’s nuclear goals

## Policies & Regulations

- **One Big Beautiful Bill Act (OBBBA):**
  - Early phaseout of tax credits for solar and wind technologies.
  - Later phaseout of tax credits for existing and new nuclear technologies.
- **Power Plant Regulations:** Removes the U.S. EPA’s Clean Air Act Section 111 regulations for fossil-fuel power plants.
- **Vehicle Regulations:** Removes EPA greenhouse gas tailpipe rule, latest CAFE standards, and Advanced Clean Truck rule.
- **Additional Updates** applied to nuclear uprates and restarts, appliance standards, EV tax credit expiration, and other updates

## Data Centers & Technology Costs

- **High Data Center Growth:** Reflects a higher expected growth rate based on published forecasts.
- **Electricity Demand** for all data centers to be fully met by grid-based electricity. The use of off-grid sources and microgrids (behind-the-meter) was not considered in this analysis – *but can be done upon request.*
- **Nuclear Technology Costs** for AP1000 and small modular reactors were updated to reflect the latest industry forecasts. Alternative costs with faster learning are also considered.

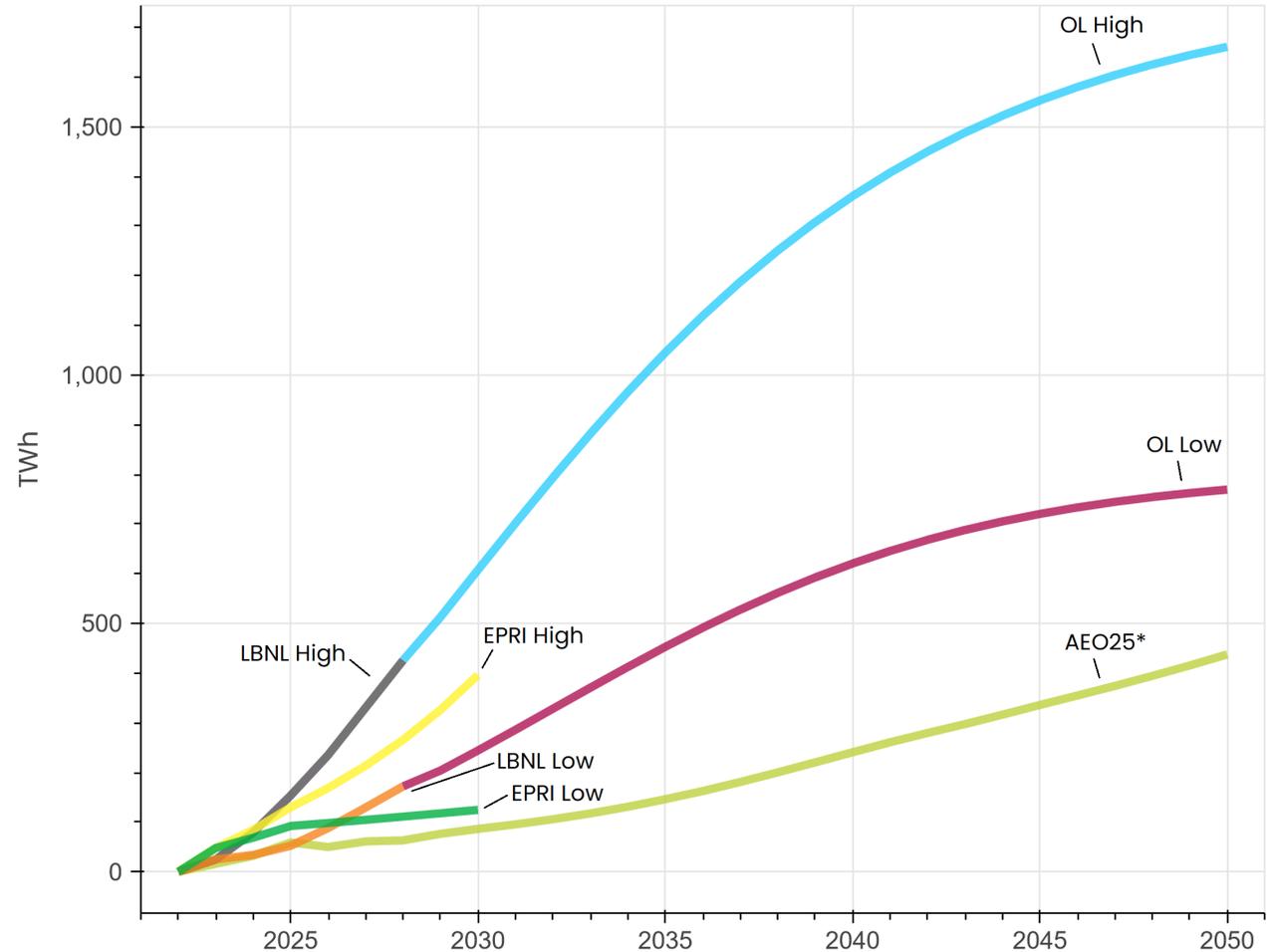
## Nuclear Power Goals & Incentives

- **Expand U.S. Nuclear Energy Capacity:**
  - By 2030: 5 GW uprates of existing reactors and start construction of ~10 new large reactors.
  - By 2050: Additional 300 GW including ~200 GW of new AP1000 reactors and ~100 GW of small modular reactors.
- **Provide “Nuclear Power Premium”** to utility sector by applying an Investment Tax Credit to supplement the OBBBA credits. **This is a proxy for additional financial support from government, industry, or both, to achieve the goals.**

# U.S. AI & DATA CENTER ENERGY DEMANDS

- Our analysis uses the **OnLocation (OL) High Growth** projection to determine the impact of expected data center demand growth.
  - Projects national data center electricity use by fitting an S-curve to Lawrence Berkeley National Laboratory's (LBNL) high-growth estimates for 2022–2028, then extrapolated.
- Other estimates, including OL Low Growth based on LBNL's lower bound estimates, and the Electric Power Research Institute (EPRI) high and low projections, show a range of estimates that highlight future uncertainty.
- Electricity Demand Projections from detailed report **Geography of Data Center Deployment** in the U.S. that provides insights into the evolving power grid response to AI data center growth and Administration policy changes. Go to <https://onlocationinc.com/news/2025/09/geography-of-data-center-deployment-energy-horizons/>

### Electricity Demand Growth by Data Centers



Source: OnLocation

\* Note: The values shown for Annual Energy Outlook 2025 (AEO25) are OnLocation's estimates of the embedded data center demand.

# NUCLEAR POWER TECHNOLOGY COSTS AND CHARACTERISTICS

*Initial assessment – more detailed and technology specific analysis possible*

## Large AP1000 Reactors

- ❖ Generating Capacity = 1,100 MW
- ❖ Overnight Capital Cost per kW: \$9,300 in 2030 down to \$6,500 by 2050
  - *With a faster technology learning rate, costs could decline to \$5,300\**
- ❖ Non-Fuel Operating Costs: \$2.61 per MWh (constant over time)
- ❖ Construction Time: 6 years

## Small Modular Reactors (NuScale SMR or similar design)

- ❖ Generating Capacity = 300 MW
- ❖ Overnight Capital Cost per kW: \$17,000 in 2030 down to \$10,800 by 2050
  - *With a faster technology learning rate, costs could decline to \$6,500\**
- ❖ Non-Fuel Operating Costs: \$3.30 per MWh (constant over time)
- ❖ Construction Time: 6 years

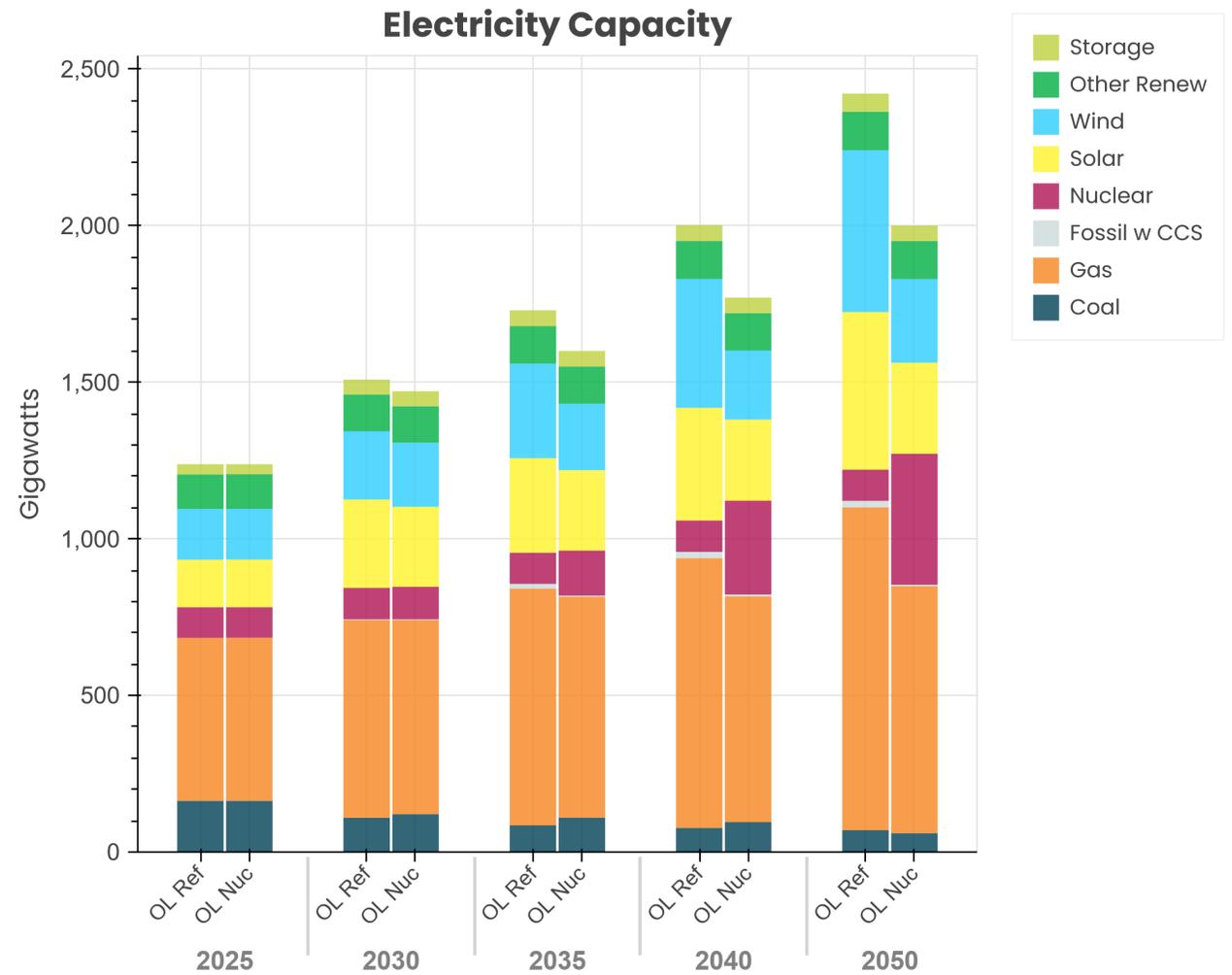
**All other power technologies use EIA's AEO 2025 assumptions**

*\*Note: Sensitivity analysis on the reactor cost was performed to account for improved learning rates and alternative SMR reactor design*



# U.S. ELECTRICITY CAPACITY

- In **both scenarios**, a large amount of investment in new capacity will be needed to meet the growing demand.
- In the **Reference Scenario**, total capacity is expected to be roughly double current levels by 2050.
- In the **Nuclear Scenario**, nuclear capacity displaces a portion of wind, solar, and natural gas generating capacity.
  - Total capacity is lower than the reference (62% higher in 2050 compared to current levels), due to a reduction in intermittent renewable capacity that has lower capacity factors and contributions to capacity reserves than nuclear.



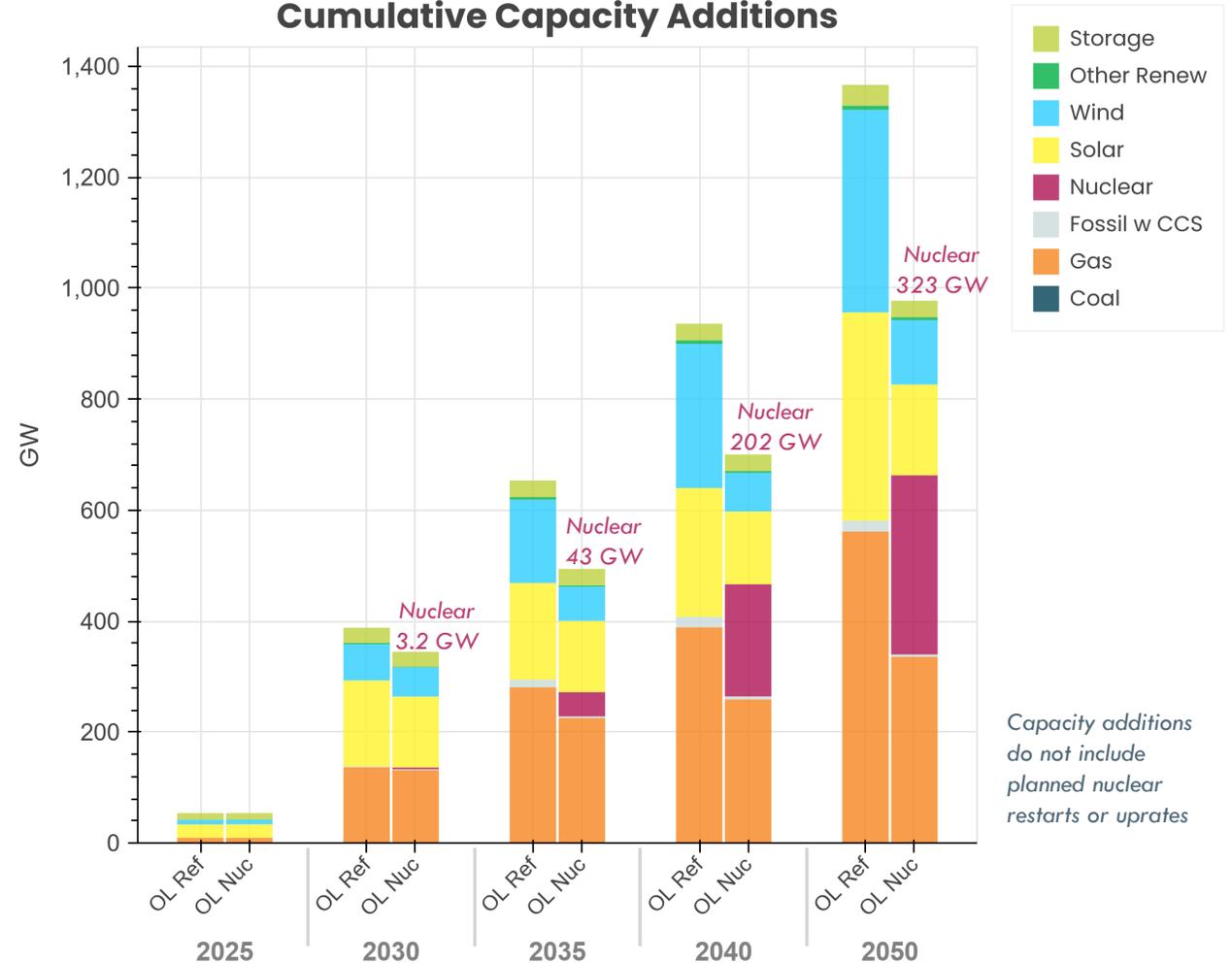
Source: OnLocation

# CAPACITY ADDITIONS

- In 2030, under the **Nuclear Scenario**, the first few SMR units and an additional AP1000 facility (since the Vogtle units) come online.
- Investments in wind and solar grow significantly slower in the Nuclear Scenario compared to the Reference Scenario, largely driven by heavy investment in baseload nuclear capacity.

Cumulative Nuclear Capacity Additions (GW)	2035	2040	2050
Small Reactors	20	79	101
Large Reactors	23	123	222
<b>Total</b>	<b>43</b>	<b>202</b>	<b>323</b>

**Cumulative Capacity Additions**



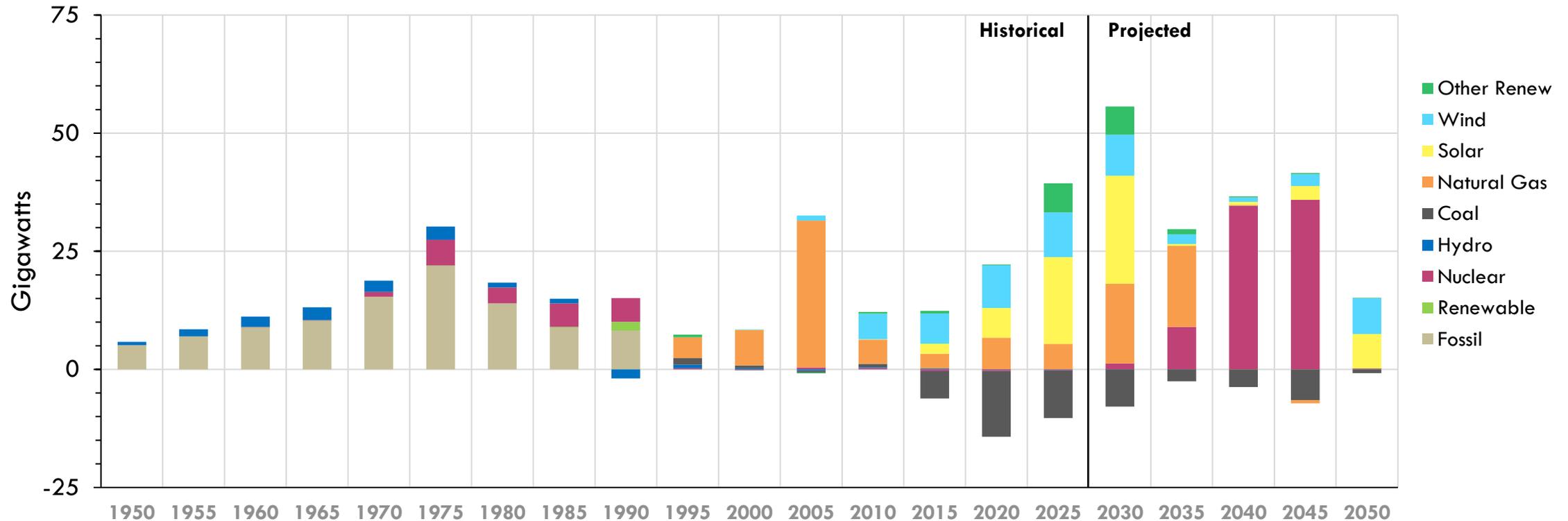
Source: OnLocation

# NET U.S. CAPACITY CHANGES HISTORICAL AND PROJECTED

*5-year annual average capacity added (Gigawatts)*

The projected buildout of nuclear to meet the Administration's targets exceeds historical capacity growth

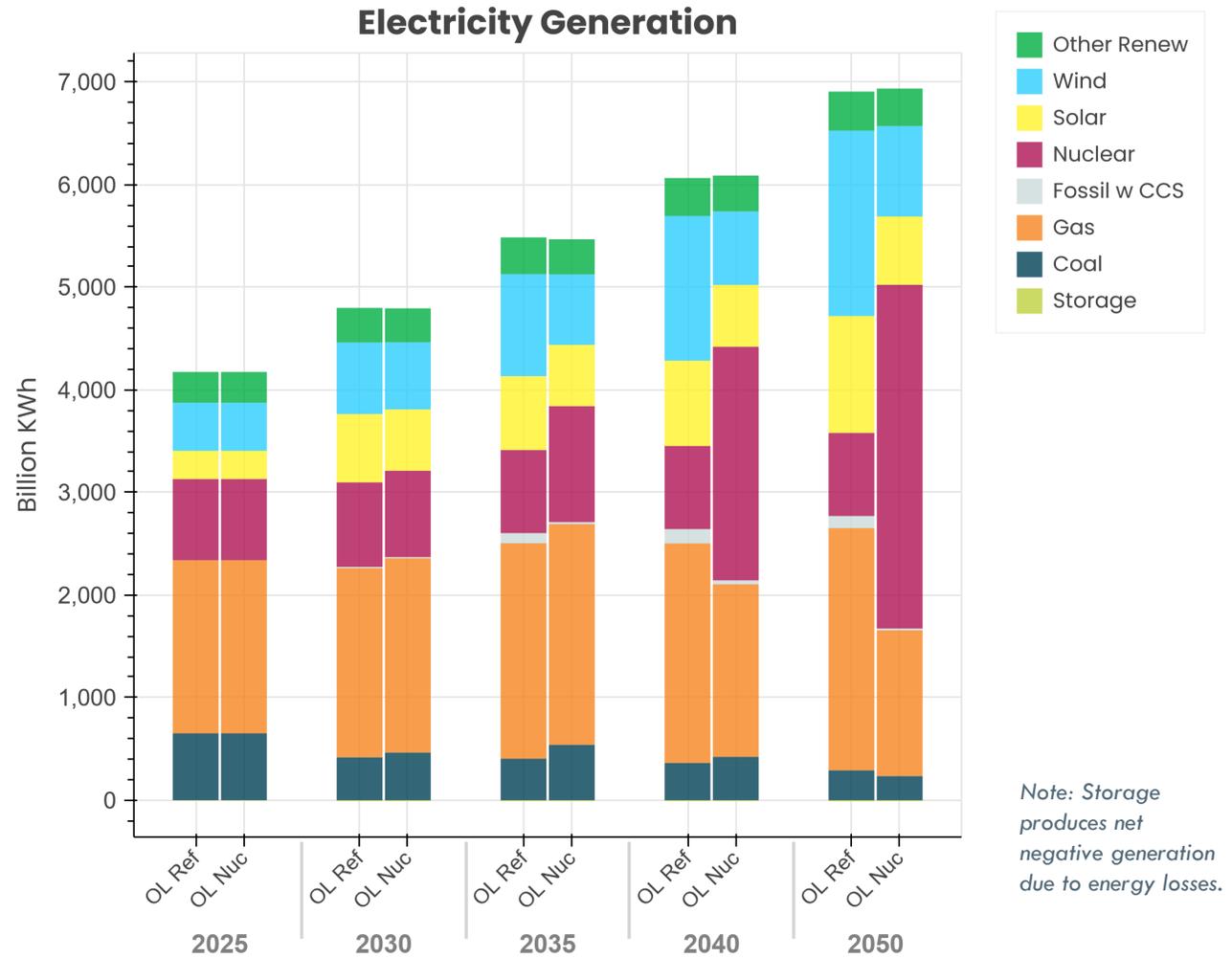
**Annual Average Net Capacity Additions**



Source: Energy Information Administration & OnLocation

# U.S. ELECTRICITY GENERATION

- The **Reference Scenario** shows a preference for generation from solar, wind, and natural gas to serve growing electricity demand.
- The **Nuclear Scenario** relies more on nuclear generation, displacing generation from renewables, natural gas and coal.
  - By 2050, in the U.S., nuclear is projected to account for 48% of generation in the Nuclear Scenario, compared to 12% in the Reference Scenario.
  - By comparison, in 2024 nuclear accounted for 67% of generation in France, 31% in South Korea and 5% in China.



Source: OnLocation

# PROJECTED U.S. ELECTRIC SECTOR CAPITAL INVESTMENT BY TECHNOLOGY

*5-year annual average investment, USD billions/year (real 2024 USD)*

Ranges for Nuclear Power investments cover the core Nuclear Scenario (higher values) and a sensitivity case that assumes faster learning rates for nuclear reactors (lower values)

Technology	2030	2035	2040	2045	2050
Natural Gas	\$19.2	\$14.8	\$5.5	\$7.0	\$5.1
Nuclear Power	\$7.8	\$80 to \$94	\$222 to 304	\$118 to \$198	\$6 to \$8
Solar Power	\$33.9	\$9.0	\$8.1	\$9.5	\$13.9
Wind Power	\$14.7	\$2.8	\$2.4	\$3.1	\$9.2
Other Renewables	\$0.5	\$0.5	\$0.4	\$0.5	\$0.4
Battery Storage	\$4.0	\$0.6	\$0.0	\$0.0	\$0.0
Transmission (HV)	\$8.67	\$4.7	\$6.5	\$5.76	\$2.6
<b>All Electric Sector</b>	<b>\$88.8</b>	<b>\$113 to \$126</b>	<b>\$245 to \$327</b>	<b>\$144 to \$224</b>	<b>\$37 to \$40</b>

# PROJECTED NUCLEAR POWER PREMIUM

*5-year annual average premium, USD billions/year (real 2024 USD)*

- Achieving the administration’s nuclear deployment goals of adding at least 300 GW of nuclear will require an average of \$99 billion per year (real 2024 USD) of additional support beyond OBBBA credits from 2026 through 2050.
- Under more ambitious technology learning assumptions, the premium required to deploy the same nuclear capacity is 30 percent lower: \$69 billion per year (real 2024 USD) over the same period

<b>5-Year Average Annual</b>	<b>2030</b>	<b>2035</b>	<b>2040</b>	<b>2045</b>	<b>2050</b>	<b>25-Year Annual Average (2026-2050)</b>
<b>Nuclear Capacity Additions (GW)</b>	0.6	8.1	31.8	23.0	1.2	13.0
<b>Premium (2024 B\$)</b>	\$6.3B	\$76.1B	\$246.5B	\$159.3B	\$6.7B	\$99B
<b>Premium (2024 B\$) Faster Technology Learning</b>	\$6.3B	\$62.7B	\$164.0B	\$108.7B	\$4.9B	\$69B

# PRIORITY QUESTIONS AND FURTHER RESEARCH

- **This analysis is a first step** in evaluating the potential for nuclear power to meet the energy needs of AI & Data Centers in line with the Trump Administration's goals.
- As regulations and policies advance, at the state and federal level, and as industry continues to investment in AI & Data Centers, **more detailed analyses can help guide future actions.**
- **Priority areas of analysis include:**
  - ✓ Electricity rate structures that protect residential consumers
  - ✓ Community acceptance of data centers and nuclear power
  - ✓ State permitting for data centers and nuclear power
  - ✓ Nuclear power additions impact on grid reliability
  - ✓ Importance of a balanced power generation portfolio
  - ✓ Assessment of a range of advanced nuclear technologies
  - ✓ Microgrids technical configuration and potential
  - ✓ What permitting reform is needed to enable accelerated electric capacity and transmission investments?
  - ✓ How will resource availability (labor, land, water) impact nuclear plant build rates by region?
  - ✓ How to restore and expand U.S. know-how on building and operating nuclear power plants?



# NUCLEAR POWER ANALYSIS HIGHLIGHTS



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**Major reforms, structural changes, and a sustained national commitment** will be required to deploy advanced nuclear power, establish a dedicated workforce, and address supply chain challenges.

## Scope of Analysis

- 1. Time Horizon:** The projections extend to 2050, and longer-term implications beyond this period are not considered. The uncertainty of future policies, data center electricity demand, and nuclear technology costs increases significantly over the time horizon.
- 2. Spatial Coverage:** This analysis is focused on U.S. energy markets and assumes business-as-usual policies in the rest of the world.
- 3. Technological Development:** While the model is comprehensive, not all emerging technologies are fully represented. Assumptions about nuclear and other future technological advancements and their adoption rates are speculative and subject to significant uncertainty.
- 4. Fossil Fuel Plants** can retire endogenously based on economics. No retention policy was assumed.

## Modeling Framework

- 1. Policy Assumptions:** Scenarios assume continuation and full implementation of current laws and regulations unless otherwise noted. Any changes in policy direction could significantly alter projected outcomes.
- 2. Economic Assumptions:** Macroeconomic growth rates, natural gas supply and prices, and other economic projections could vary with market fluctuations and policy changes.
- 3. Market Behavior:** Assumptions about market acceptance of new technologies, such as small modular reactors, are uncertain and may not materialize as projected.
- 4. Modeling Challenges:** As with all models, OL25-NEMS is an economic abstraction of the energy industry and may not fully reflect the complexities associated with significant energy transitions including electric grid reliability and infrastructure buildout.

## Other Uncertainties

- 1. Current Data Center Demands:** Even current demands are uncertain with an almost 2-fold estimated range in published sources.
- 2. Central vs. On-site Generation:** Grid-based power sources for data centers are assumed in this analysis. While critical for maintaining grid reliability, backup generation and microgrids are not explicitly modeled.
- 3. Executive Orders** aimed at addressing limitations in nuclear fuel availability, supply chain, licensing, and workforce skills, are assumed to be successfully implemented.

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# ABOUT SYSTEM ONE

system|one

System One, Key Logic's parent company, is a leading provider of specialized, highly technical outsourced services and workforce solutions to critical infrastructure, technology, life sciences, and government sectors. As a diversified organization, we operate in over 50 locations and put more than 10,000 people to work in the United States, Canada, the United Kingdom, and Brazil.

System One energizes the nation's power and utility providers, ensuring the talent and project resources needed to support critical initiatives, meet today's energy demands, and prepare for tomorrow's opportunities. For more than 40 years, nuclear energy has been a core part of System One's business, and we support the entire nuclear power generation lifecycle — from licensing and construction to operations, maintenance, and decommissioning.

Through companies like **KeyLogic**, System One provides specialized expertise across:

- › Nuclear Energy
- › Transmission & Distribution
- › Construction & Maintenance
- › Utility Services
- › Environmental & Inspection Services
- › Oil & Natural Gas
- › QA/QC & NDE
- › Renewable Energy

Our expertise empowers industry and government leaders to evaluate emerging technologies and make informed decisions that will shape the future of the U.S. energy sector.





# What Would It Take? Pathways to 400 GW of U.S. Nuclear Capacity

Contact KeyLogic for a free consultation on a customized analysis of the U.S. energy system

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