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Materials will be available at:
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Artificial Intelligence: Implications for Energy and the Environment

Thursday, September 25, 2025

About EESI

EESI
Environmental and Energy Study Institute

Nonpartisan Educational Resources for Policymakers

A bipartisan Congressional caucus founded EESI in 1984 to provide nonpartisan information on environmental, energy, and climate policies

Direct Assistance for Equitable and Inclusive Financing Program

In addition to a full portfolio of federal policy work, EESI provides direct assistance to utilities to develop “on-bill financing” programs

Commitment to Diversity, Equity, Inclusion, and Justice

We recognize that systemic barriers impede fair environmental, energy, and climate policies and limit the full participation of Black, Indigenous, people of color, and legacy and frontline communities in decision-making

Sustainable Solutions

Our mission is to advance science-based solutions for climate change, energy, and environmental challenges in order to achieve ***our vision of a sustainable, resilient, and equitable world***

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Live, in-person and online public briefings, archived recordings, and written summaries

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Timely, objective coverage of environmental, clean energy, and climate change topics

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Active engagement on Bluesky, Facebook, LinkedIn, X, and YouTube

Upcoming Briefings

EESI
Environmental and Energy Study Institute

Artificial Intelligence: Implications for Energy and the Environment
Thursday, September 25, 3:30–4:30 PM

Grid Modernization
Thursday, October 9, 3:30–5:00 PM

How Can We Cut Industrial Emissions?
Wednesday, October 22, 9:00–10:00 AM

What Congress Needs to Know About COP30
November 4 – 6, 12:00–1:00 PM

Sign up for our *Climate Change Solutions* newsletter here: eesi.org/signup

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What did you think of the briefing?

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Thursday, September 25, 2025

RUTGERS
NEW BRUNSWICK

AI for Energy Innovation:

Insights, Examples, and Projections from an Energy Research Lab

Ahmed Aziz Ezzat, Ph.D.

Assistant Professor, School of Engineering, Rutgers University

Faculty Affiliate, Rutgers Climate & Energy Institute (RCEI)

Scholarly Affiliate, Rutgers Data Science & AI Collaboratory (RAD)

Lab Director, Renewables & Industrial Analytics (RIA) Research Lab

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Energy Operations Under Uncertainty: Role of AI

Modern-day energy systems operate under a set of **rapidly evolving uncertainties**, experiencing dramatic shifts due to a multitude of factors.

AI-powered load forecasts

- *Extreme weather*
- *Electrification, Onshoring*
- *AI, Data centers, Large loads*
- *Changing consumer behavior*

Energy Demand

How much energy do we need?

AI-powered energy forecasts

- *Dynamic & extreme weather*
- *Dependencies & Complementarities*
- *Storage, Distribution, Transmission*

AI

AI-powered price forecasts

- *Demand growth*
- *Extreme weather*
- *Economics & Policy*

How much energy do we produce?

How much does energy cost us?

Energy Supply

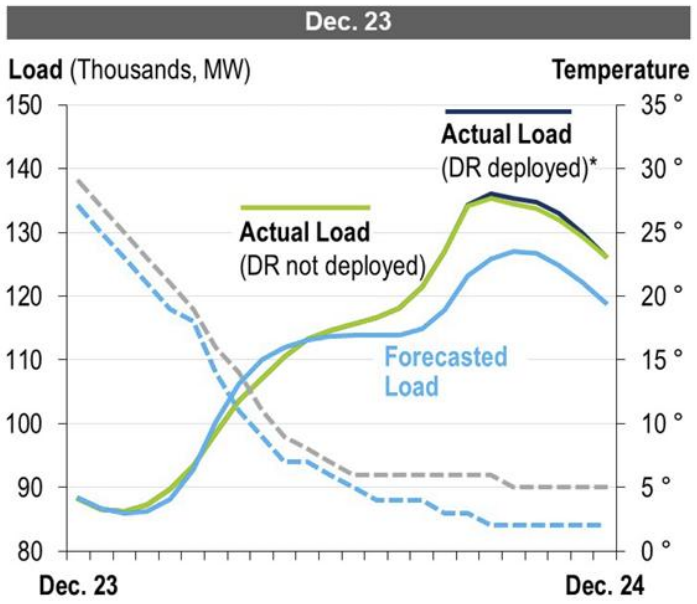
Energy Prices

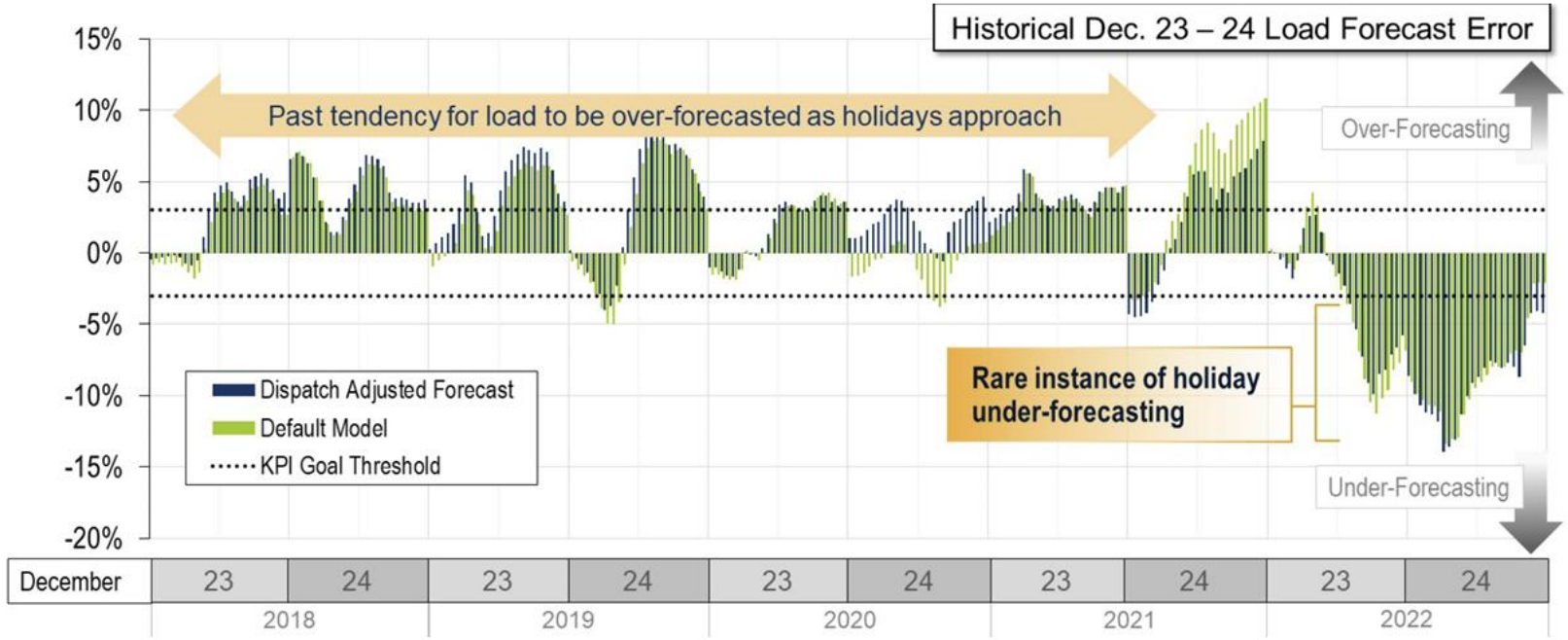
AI can play a critical role in minimizing these uncertainties through **capable forecasting tools** that can better adapt to **dynamic, non-linear, and rare events**.

A real-world example: Pushing the boundaries of forecasting

From PJM report on Storm Elliot (December 2022): *"The load forecast is determined by an algorithm that considers expected weather conditions, day of the week and holidays…. The extreme weather … included bitter cold temperatures that were outside of the data sample used to train the load forecast models…"*

Source: Winter Storm Elliott Event Analysis and Recommendation Report July 17, 2023, PJM.



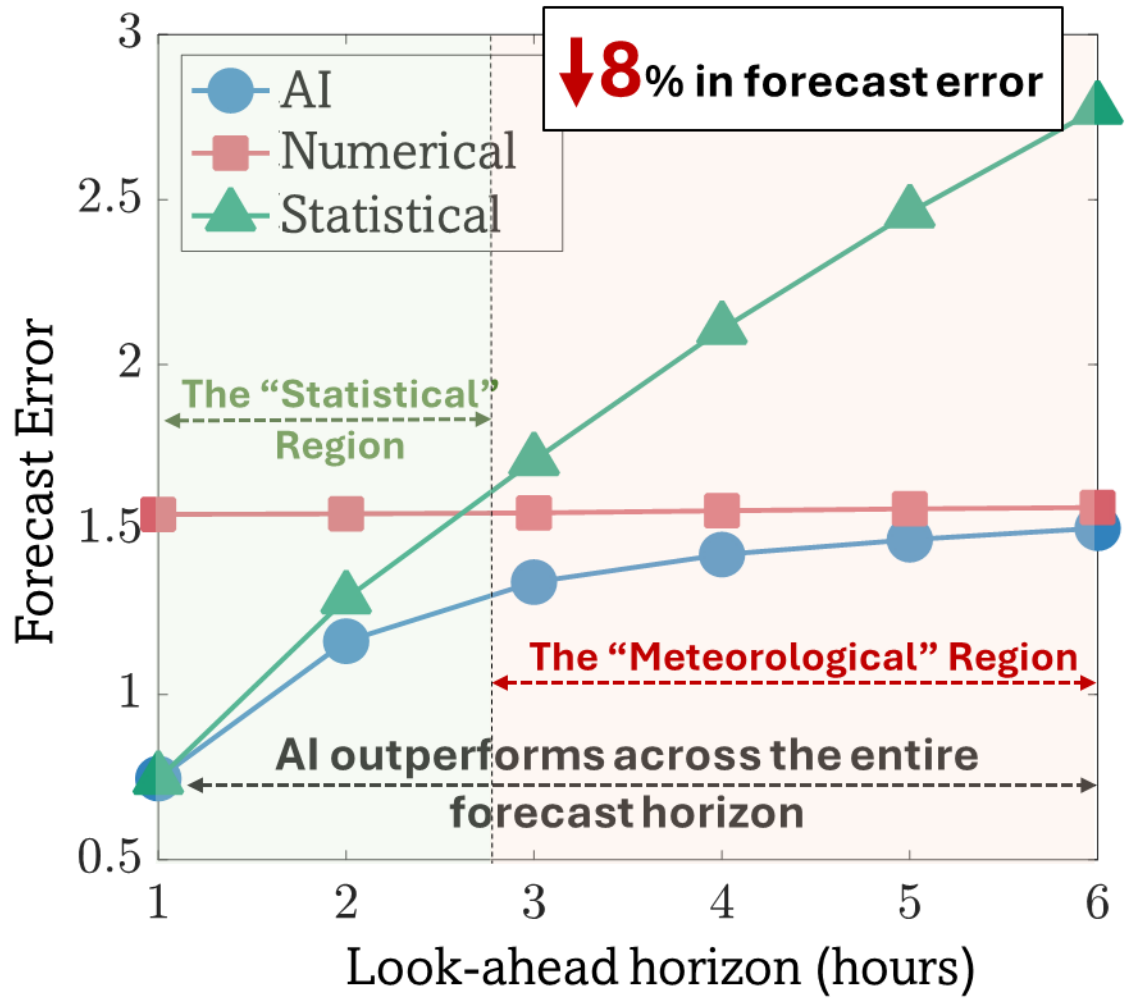


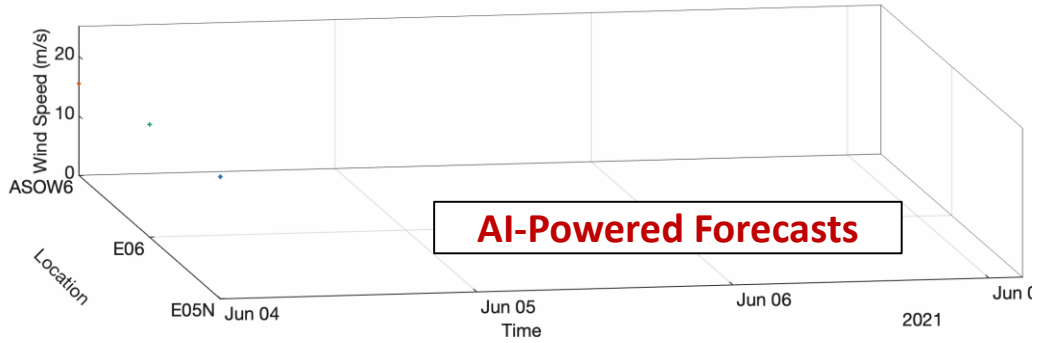
Why can AI be the answer? It's not only about data volume… AI can unlock:

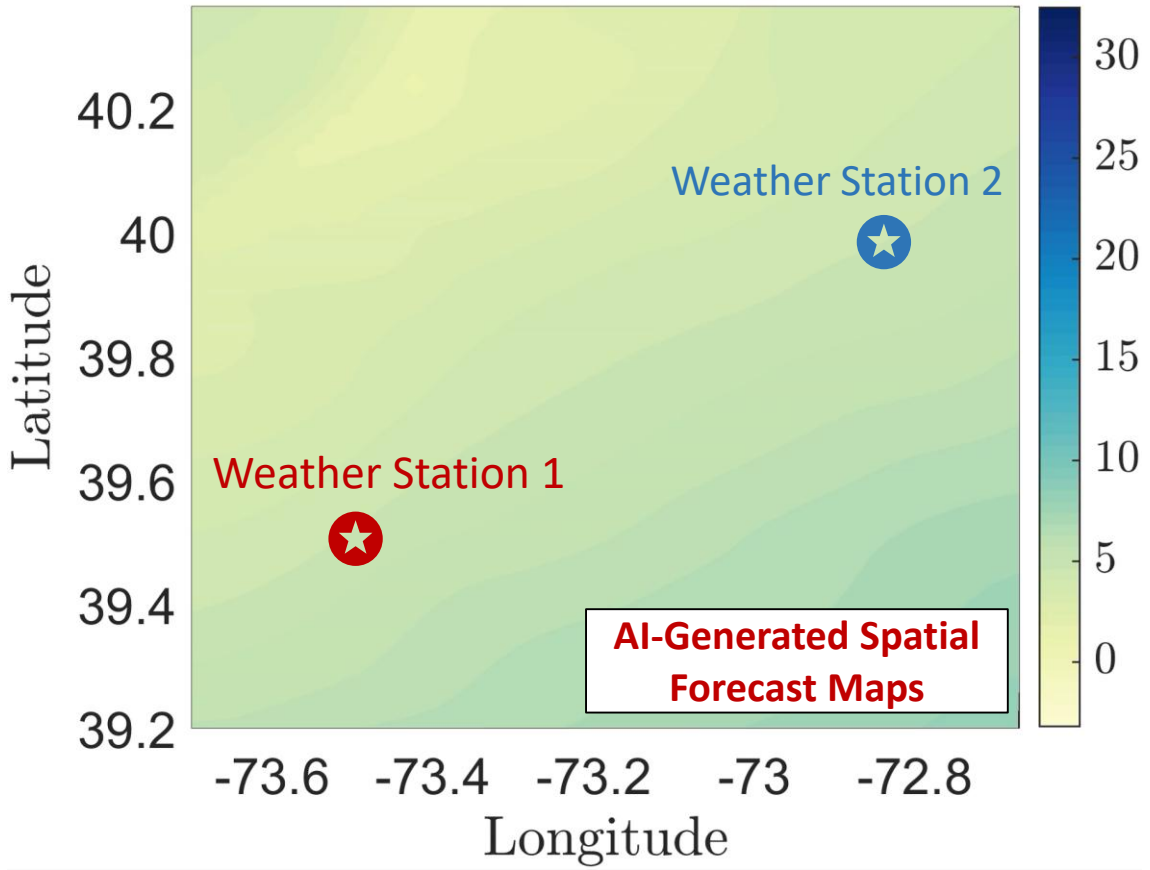
- Multiple **data modalities** (e.g., image, text, time series, event data)
- Multiple **data sources** (e.g., satellites, numerical products, smart meters, weather stations, social signals)
- **Generative capabilities** for improved generalization.
- Ability to rapidly adapt to **dynamic**, **complex**, and **rare events**, based on multi-modal and multi-source data.

Better forecasts = Better operations
(cost, reliability, environmental footprint)

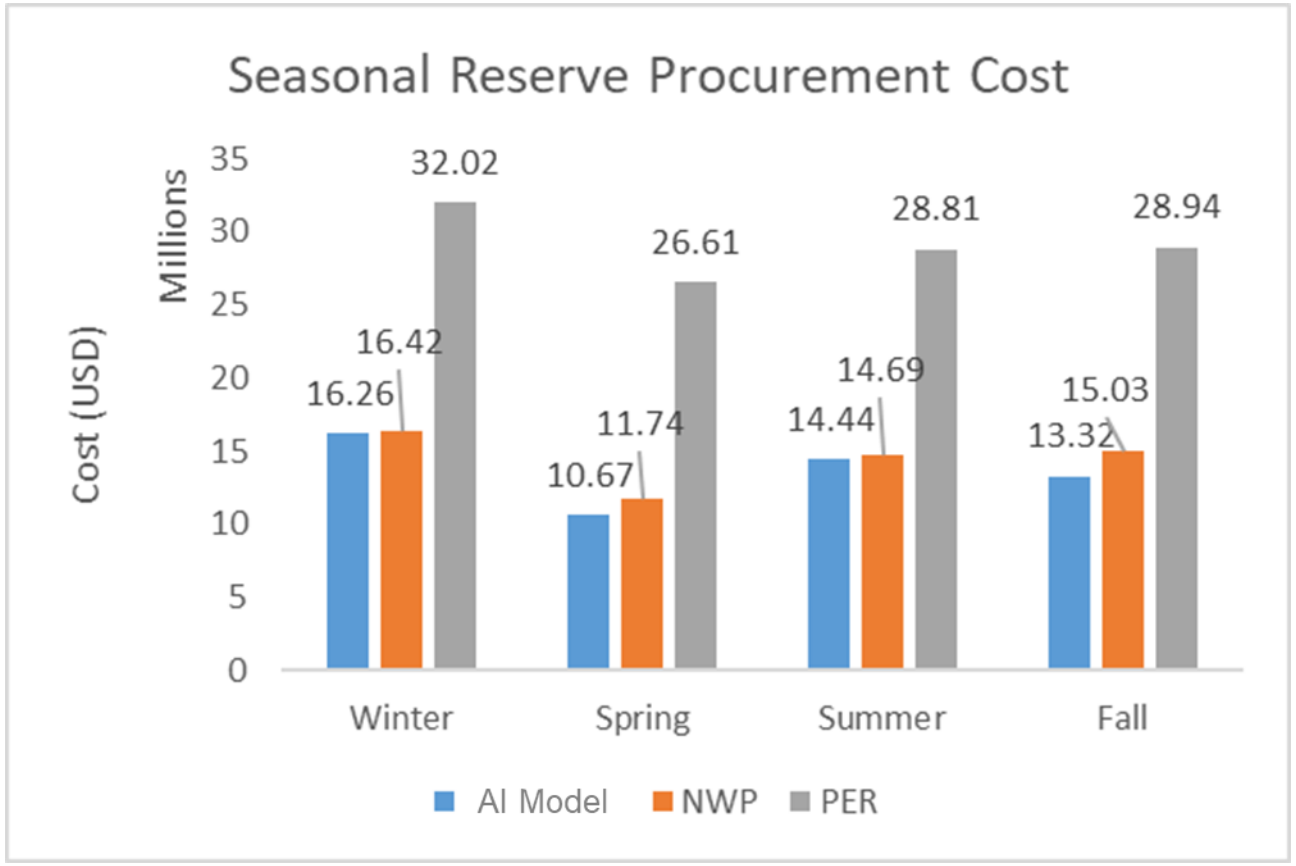
Example 1: AI-Powered Short-term Weather Forecasting for Energy System Operation

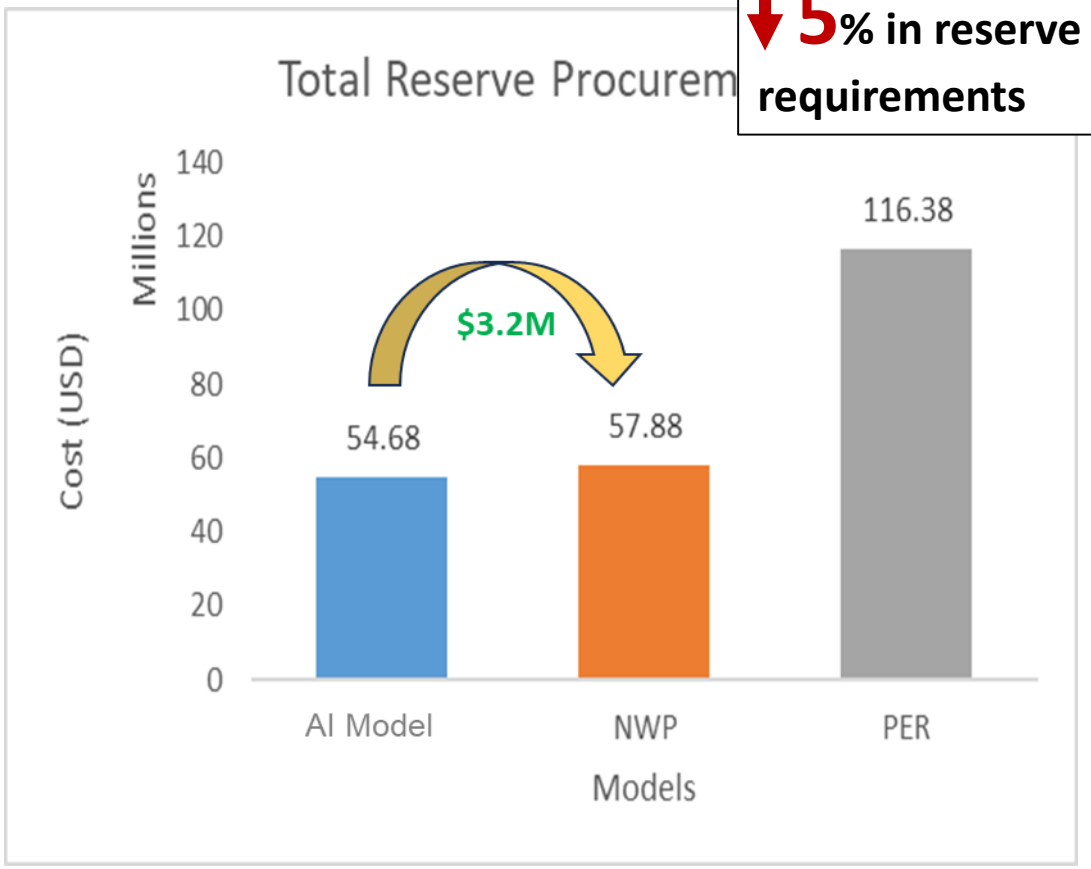






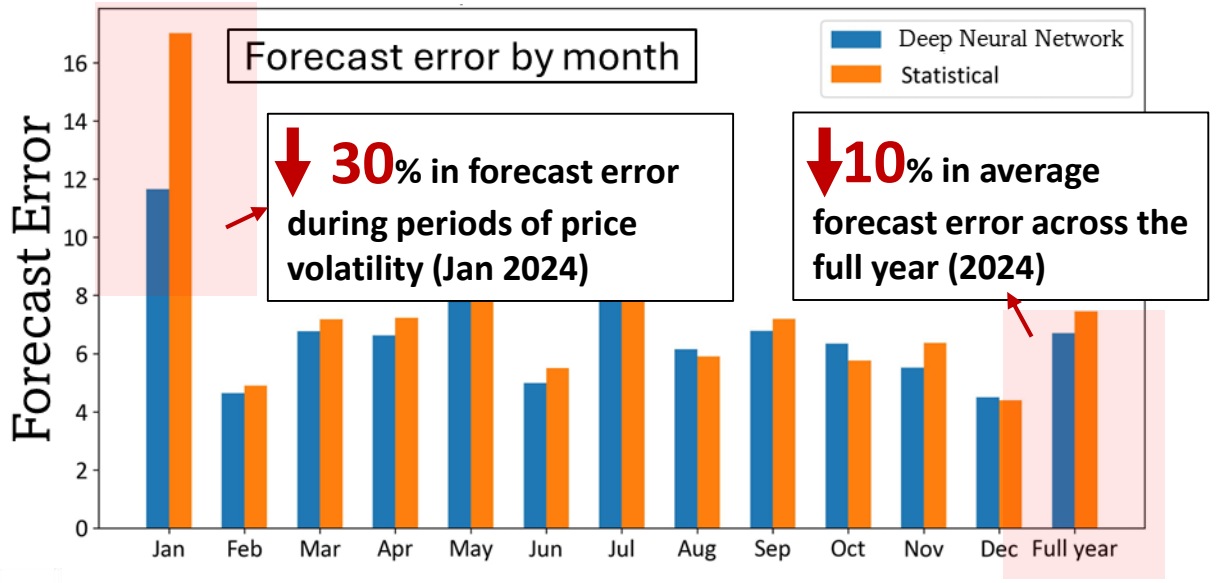
Example 1: AI-Powered Short-term Weather Forecasting for Energy System Operation

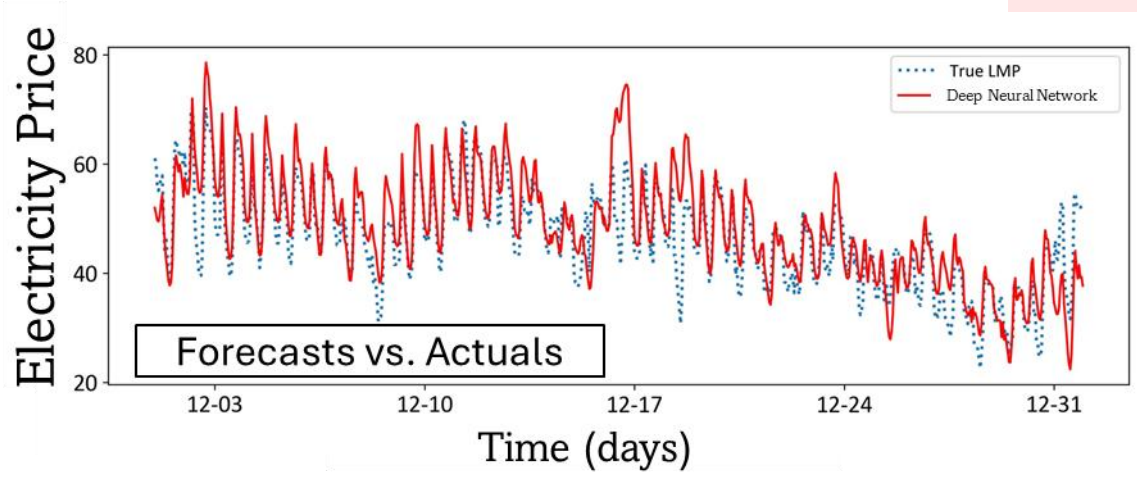


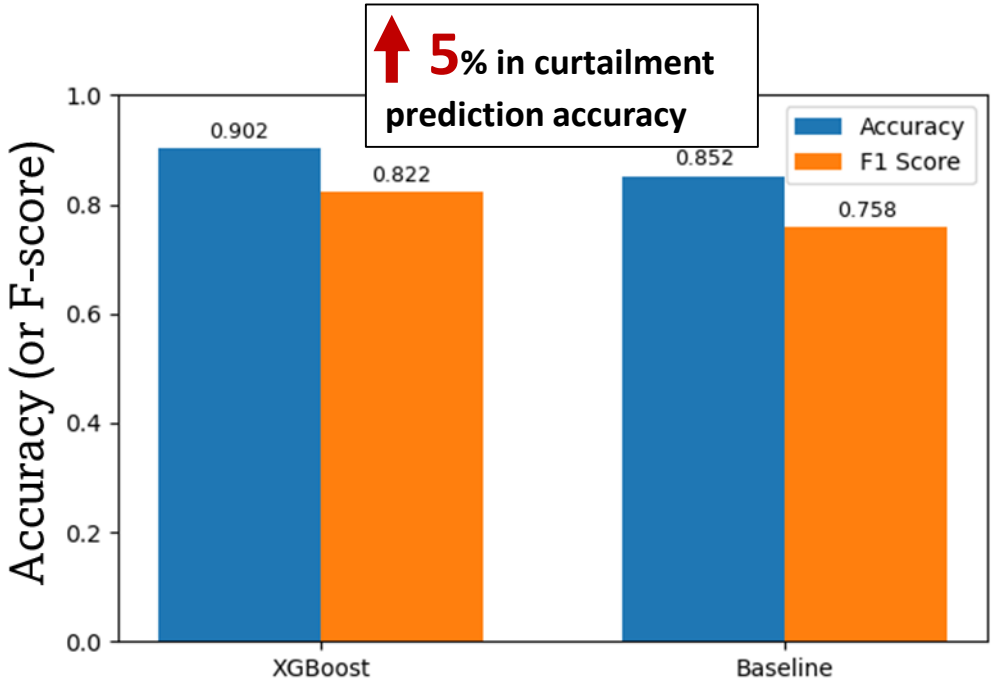


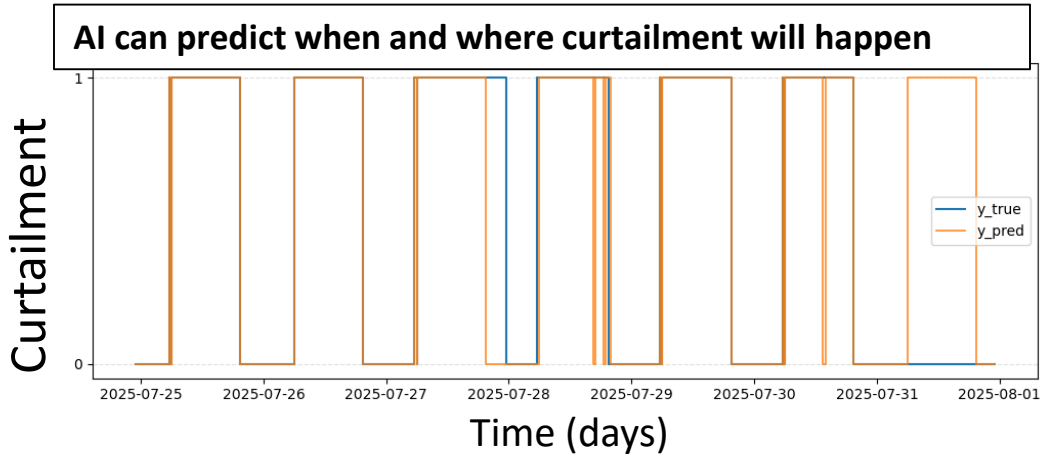
↓5% in reserve requirements

Example 2: AI-Powered Short-term Electricity Price and Curtailment Forecasting









Thoughts and Takeaways:

- **AI unlocks the Big Data Era:** By integrating diverse data modalities and sources, and by leveraging generative capabilities, AI allows us to extract more from information, learning what traditional models cannot.
- **AI reduces uncertainty in energy operations:** Better forecasting of demand, supply, and prices can make energy systems more efficient, more reliable, and more sustainable.
- **Many examples to highlight:** AI for predictive maintenance, for load forecasting, and for co-existence of energy systems with environmental habitats.
- **The benefits of AI can potentially outweigh its costs, but efficiency matters:** If developed responsibly, AI can be a net generator of value, delivering system efficiency, reliability, and environmental gain, but we must invest in Frugal AI — models that achieve high performance without excessive computational or energy costs.
- **Collaboration is key:** Crowdsourcing AI (data, models, computational resources) to scientists, researchers, and students, can accelerate innovation and broaden impact of AI.
- **Prepare the next generation:** Training AI-literate engineers and scientists is essential to fully harness the opportunities and promise of AI.

AI4E

AI FOR ENERGY

ARTIFICIAL INTELLIGENCE: IMPLICATIONS FOR ENERGY AND THE ENVIRONMENT

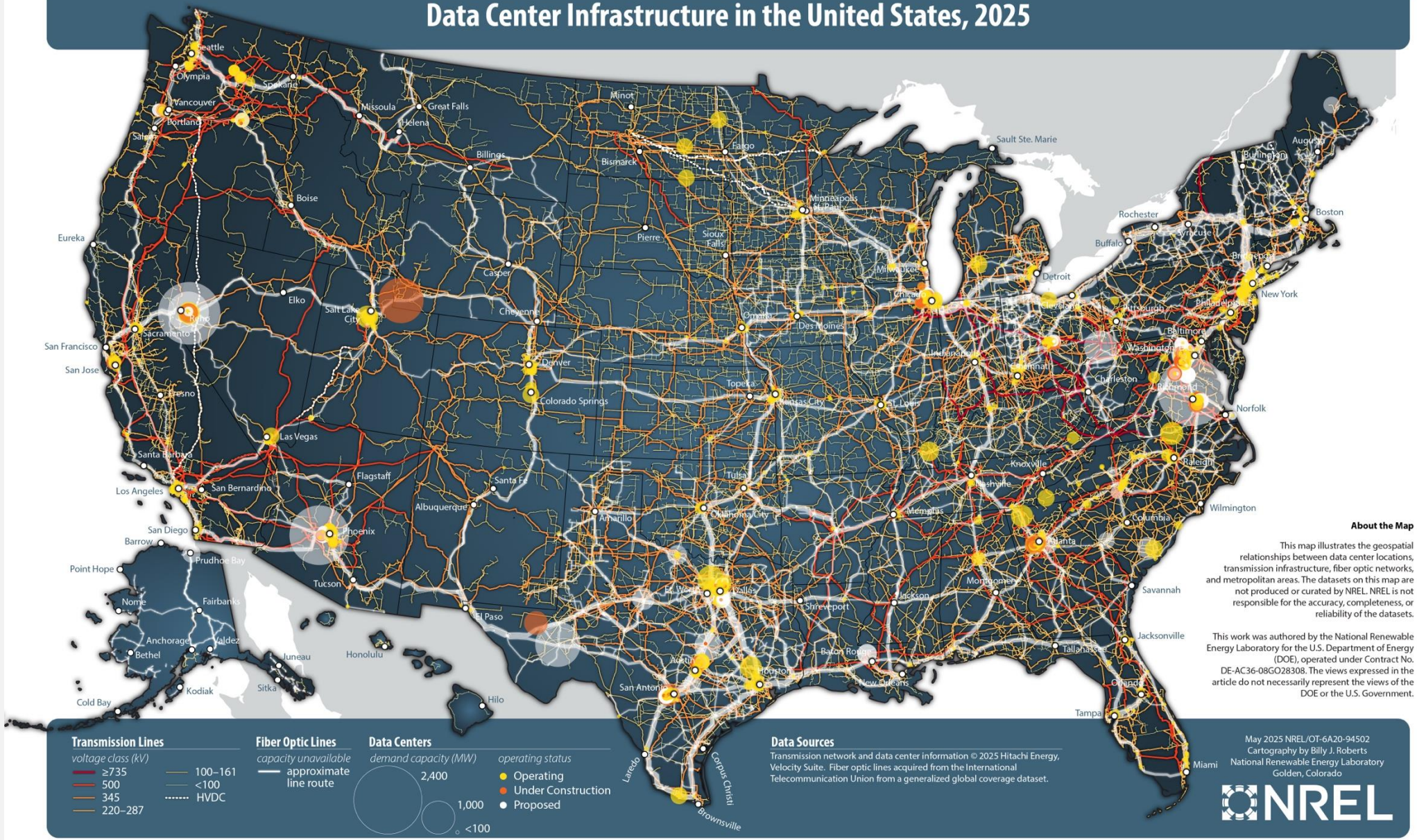
Fatima Ahmad, Founder & CEO, AI For Energy LLC

Environmental and Energy Study Institute Briefing (Sep. 25, 2025)

[T]here is no AI without energy. At the same time, AI has the potential to transform the energy sector."

-International Energy Agency, Energy and AI (April 2025)

Data Center Infrastructure in the United States, 2025



About the Map

This map illustrates the geospatial relationships between data center locations, transmission infrastructure, fiber optic networks, and metropolitan areas. The datasets on this map are not produced or curated by NREL. NREL is not responsible for the accuracy, completeness, or reliability of the datasets.

This work was authored by the National Renewable Energy Laboratory for the U.S. Department of Energy (DOE), operated under Contract No. DE-AC36-08GO28308. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government.

Transmission Lines

voltage class (kV)

- ≥735
- 500
- 345
- 220–287
- 100–161
- <100
- HVDC

Fiber Optic Lines

capacity unavailable

- approximate line route

Data Centers

demand capacity (MW)

- 2,400
- 1,000
- <100

operating status

- Operating
- Under Construction
- Proposed

Data Sources

Transmission network and data center information © 2025 Hitachi Energy, Velocity Suite. Fiber optic lines acquired from the International Telecommunication Union from a generalized global coverage dataset.

May 2025 NREL/OT-6A20-94502
Cartography by Billy J. Roberts
National Renewable Energy Laboratory
Golden, Colorado

NREL

BERKELEY LAB

Energy Analysis & Environmental Impacts Division

2024 United States Data Center Energy Usage Report

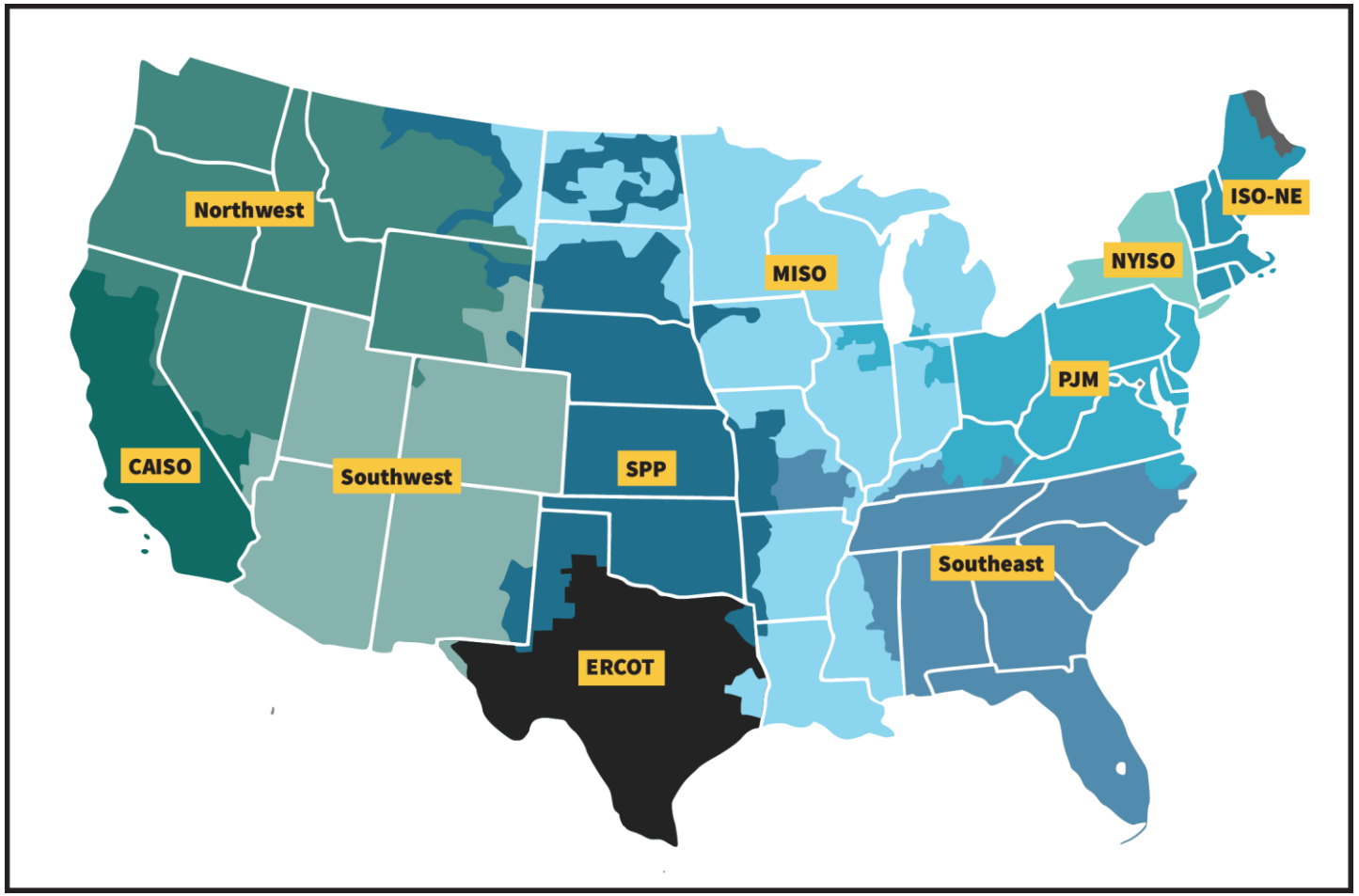
Arman Shehabi, Sarah J. Smith, Alex Hubbard, Alex Newkirk, Nuoa Lei, Md Abu Bakar Siddik, Billie Holecek, Jonathan Koomey, Eric Masanet, and Dale Sartor
Energy Analysis and Environmental Impacts Division, Lawrence Berkeley National Laboratory

December 2024

DATA CENTER ENERGY USE IS RISING

This work was supported by the DOE Office of Energy Efficiency and Renewable Energy (EERE), Office of Industrial Efficiency and Decarbonization Office (IEDO) under Lawrence Berkeley National Laboratory Contract No. DE-AC02-05CH11231.

"Data center load growth has tripled over the past decade and is projected to double or triple by 2028."



Source: U.S. Federal Energy Regulatory Commission

REGIONAL GRID OPERATORS

NEW ENERGY POLICY RECOMMENDATIONS

"Develop a Grid to Match the Pace of AI Innovation"

U.S. DEPARTMENT OF ENERGY

The DOE National Labs are at the leading edge of AI for Energy & AI for Science.

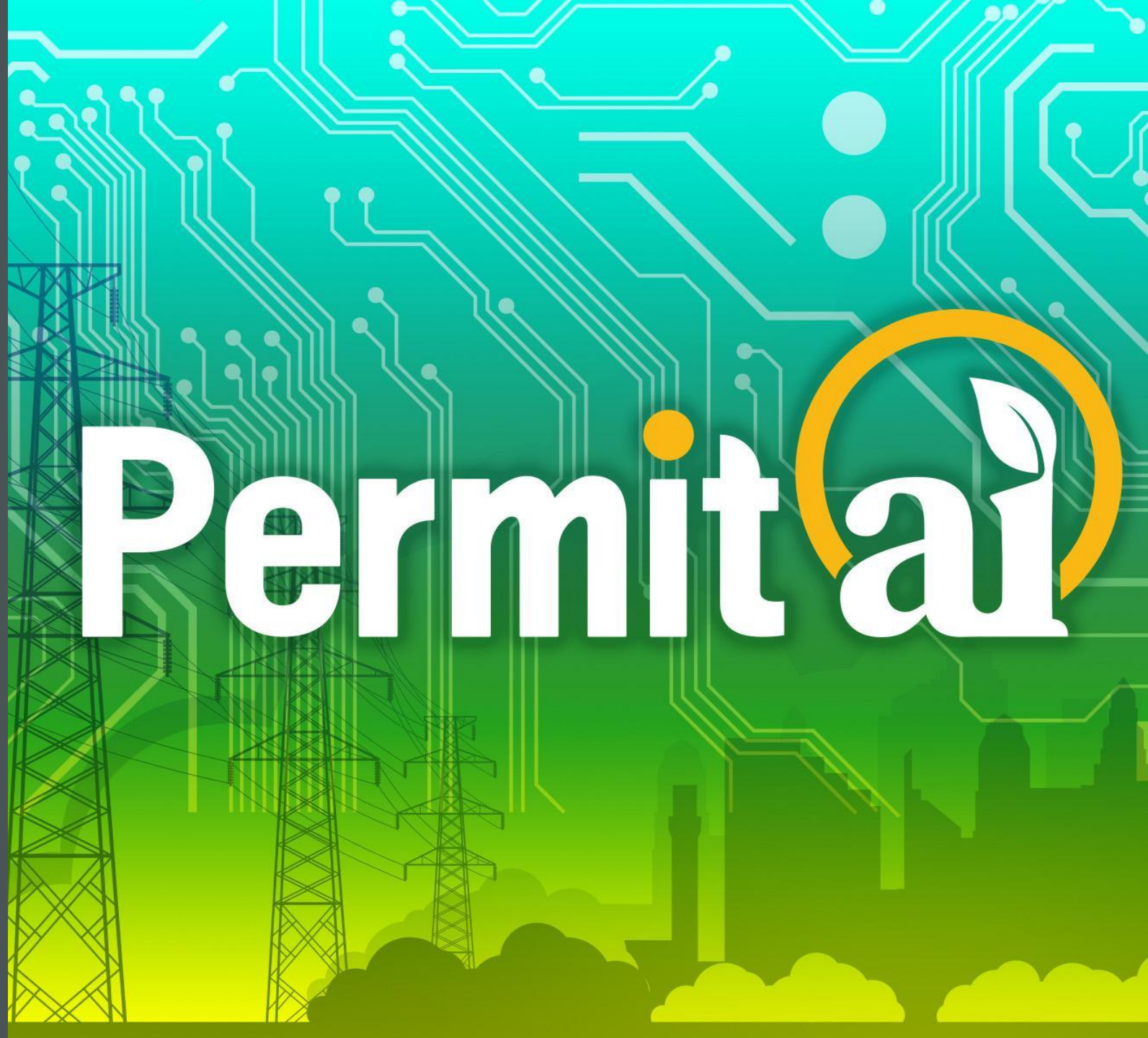
AI for Energy

Opportunities for a Modern Grid and Clean Energy Economy

April 2024

U.S. DEPARTMENT OF ENERGY

- The Pacific Northwest National Laboratory is "clearing the path for critical infrastructure"



AI FOR ENERGY

AI for Nuclear Energy

AI for Fusion

AI for Geothermal Energy

AI for Critical Minerals

AI for the Electric Grid

AI for Energy Efficiency

AI for Water

QUESTIONS?

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