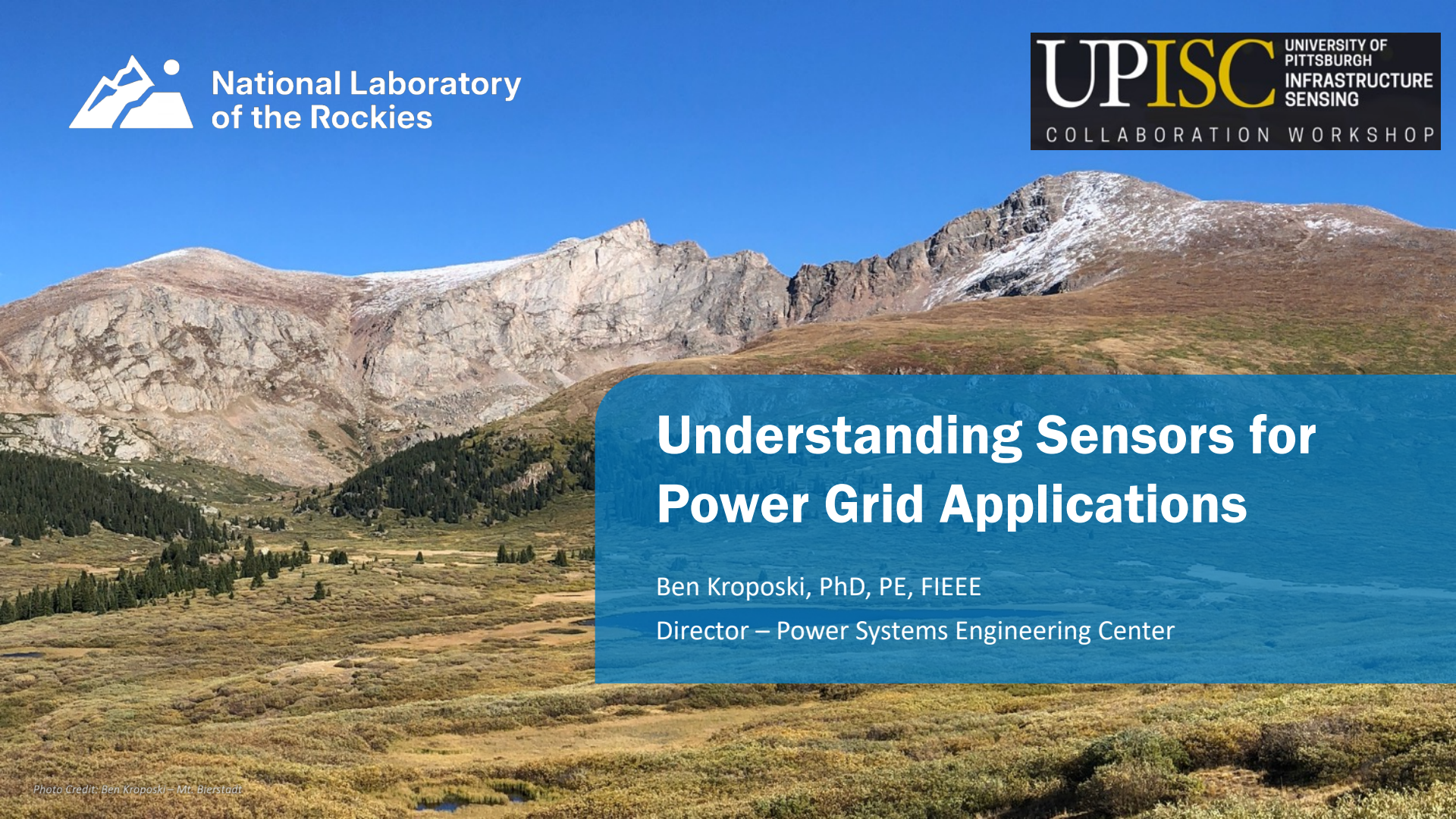
National Laboratory of the Rockies

UPISC UNIVERSITY OF PITTSBURGH INFRASTRUCTURE SENSING COLLABORATION WORKSHOP



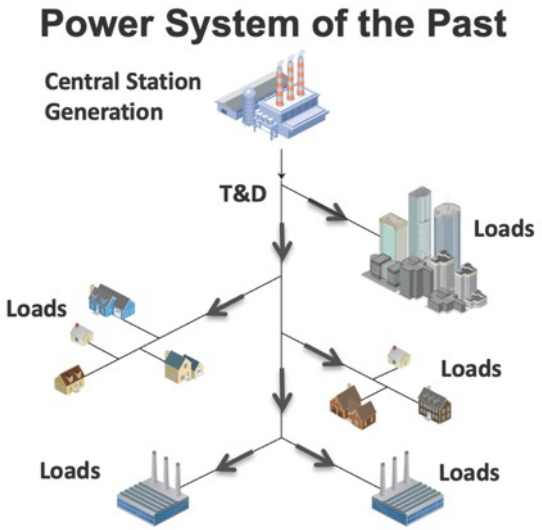
Understanding Sensors for Power Grid Applications

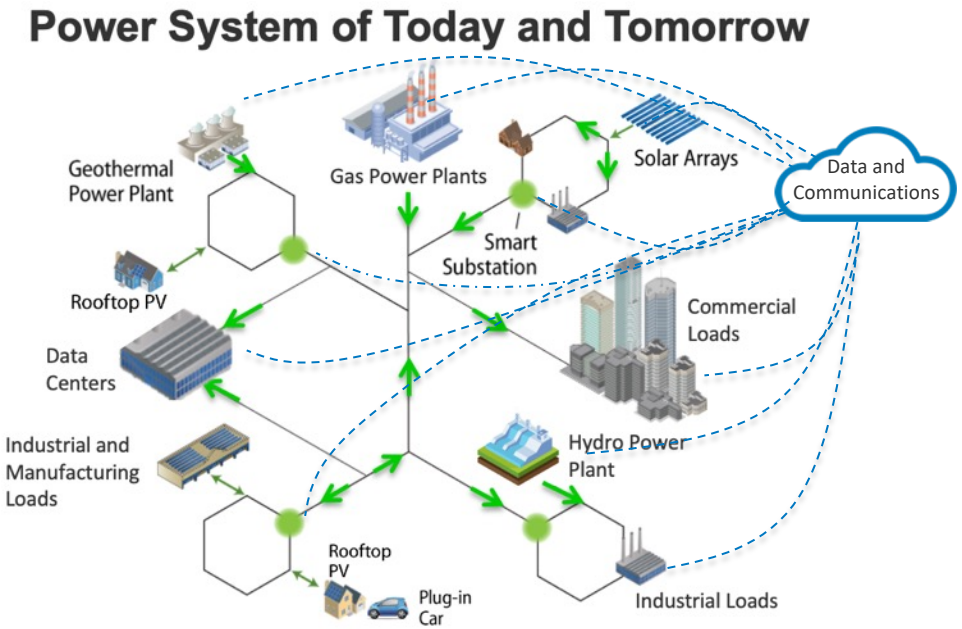
Ben Kroposki, PhD, PE, FIEEE

Director – Power Systems Engineering Center

Photo Credit: Ben Kroposki – Mt. Bierstadt

Grid Changes and the Need for Innovative R&D



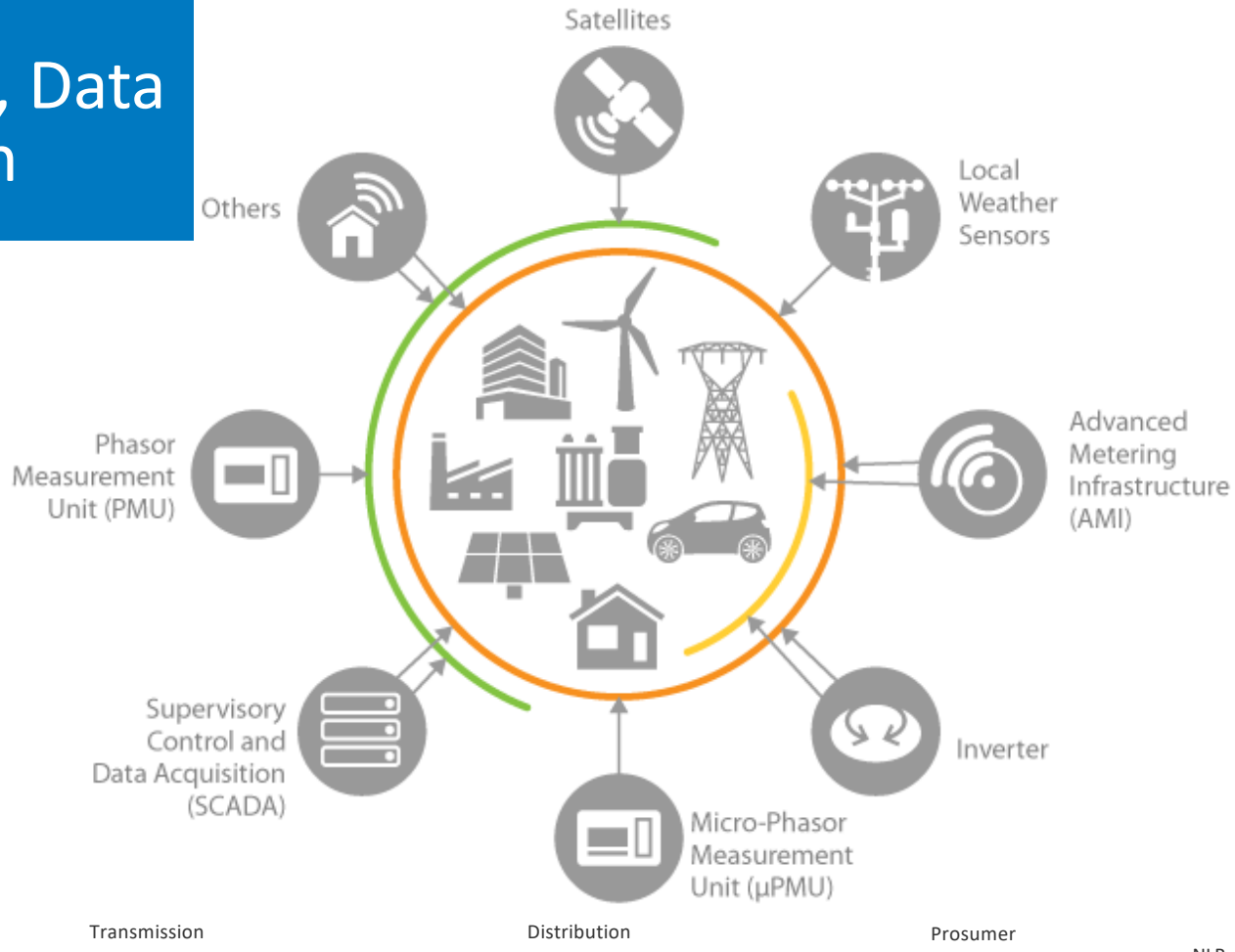


Changes Happening in the Grid:

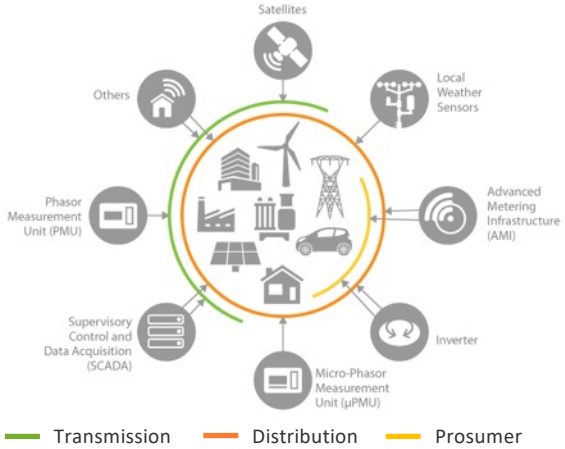
- **Growing Loads:** Increased energy use from data centers and AI >> 15% increase over last decade of flat load growth
- **Aging Infrastructure and Supply Chain:** Most grid components are over 25 years old
- **Evolving Threats and Hazards:** Increasing impact of weather events, wildfires, and cyber attacks
- **Increasing Interdependencies:** Increasing connections between electricity, natural gas, water, and communications
- **More Power Electronics:** Power electronics-based generation, storage and loads have unique characteristics
- **More Data and Communications:** More use of communications, digital controls, and data

Sensing, Measurement, Data Collection

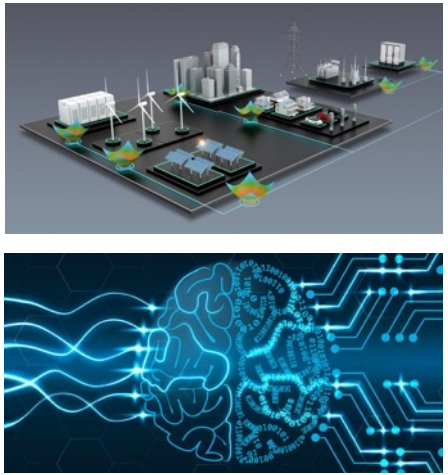
Understanding multiple sensing platforms with spatially distributed sensing capability (e.g. optical fiber sensing, passive wireless sensors, electrochemical sensors, chip sensors)



Merging Sensing, Measurement, Data Collection with AI



Domain Knowledge



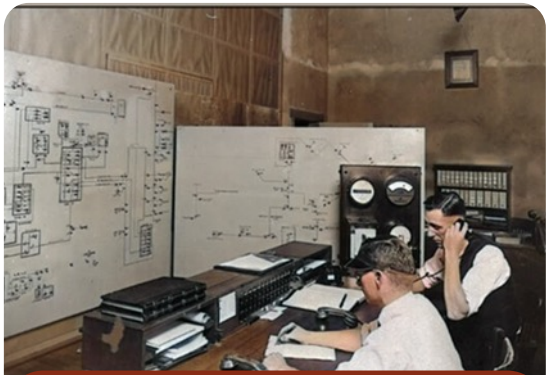
AI

Intelligent Decision-Making

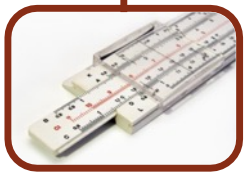
Affordable, Reliable, Secure Power Systems

Coupling with physics-based modeling and artificial intelligence (AI)-enabled sensor networks and digital twin technologies for specific infrastructure needs.

Adding Technology to the Grid



Past
No Computer/Analog



Slide rule

Calculator

Present
Computer/Digital

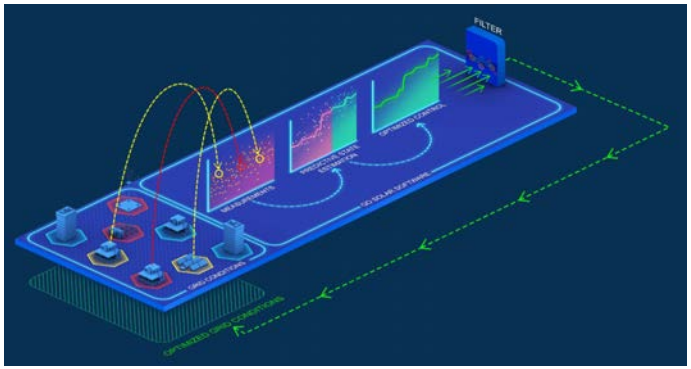
Computer

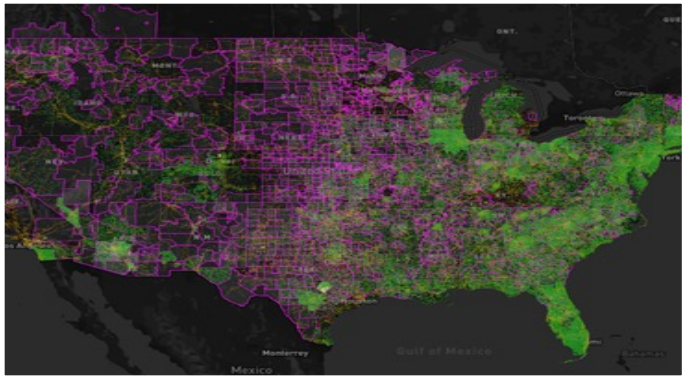
Internet

Future
Digital Transformation

Generative AI

Connecting Grid Sensing with Analytics



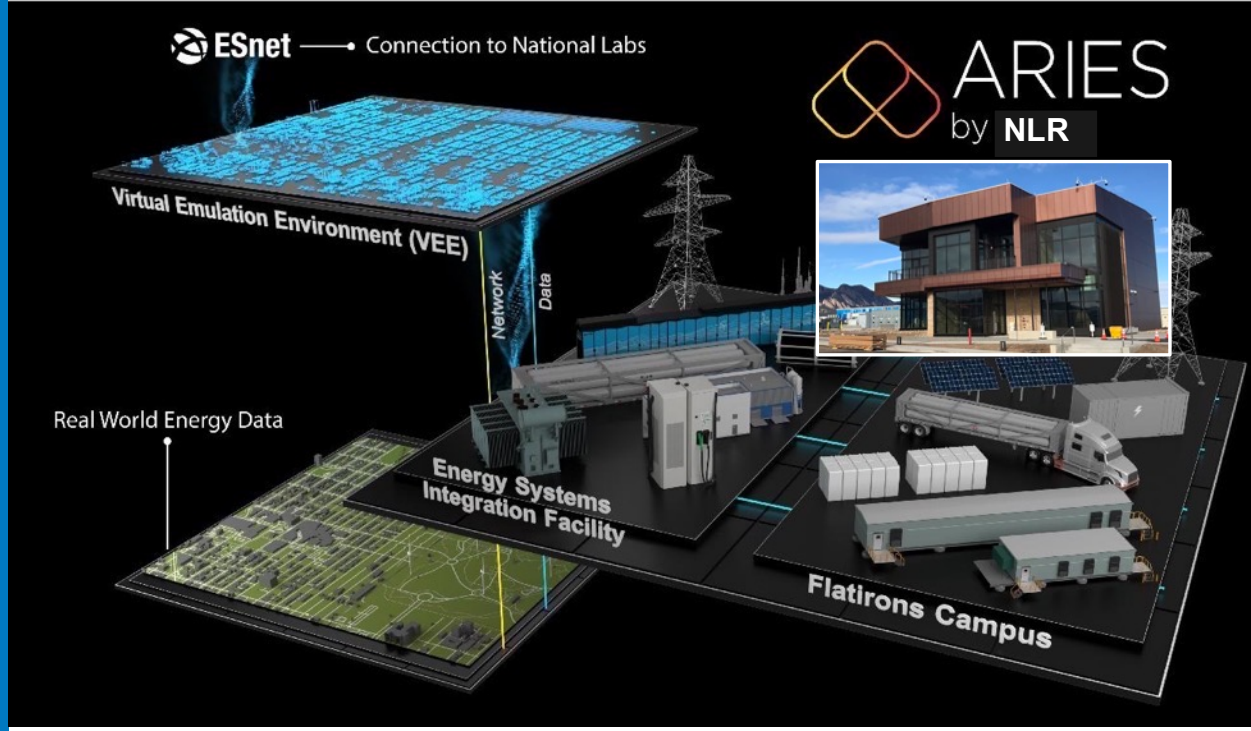


- Situational awareness: Estimation, forecasting, uncertainty quantification
- Inform operations: DER flexibility and risk management, optimization and fault prediction
- Data-driven modeling & analysis: Inverter dynamics, stability assessment, system response for cyber-physical events

AI can help forecast, automate, and optimize operations and decision-making for highly complex energy systems.

How can we validate the AI performance and ensure AI is trustworthy?

ARIES can provide a research platform to connect between AI running in the Virtual Environment and ARIES Hardware Platform and Real World Data.



ARIES validates a broad range of future energy technologies and grid modernization scenarios alongside stakeholders to achieve an **affordable**, **secure**, and **reliable** energy system.