



Advanced Research on Integrated Energy Systems (ARIES)

PEGI Workshop
May 24th 2023
Jerry Davis

ARIES



Energy Systems Integration Facility



Flatirons Campus

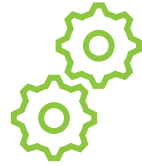


Virtual Emulation Environment

ARIES Envisioned in 2019



**DOE EERE Office
Directors' Summit 2019**



**DOE & NREL Draft R&D Plan
2019-2020**



**DOE Launches ARIES
2020**

Problem: Rapidly changing energy systems have many needs and risks

R&D challenges and research areas

Cross-office alignment

Opportunity: Research platform to de-risk large-scale systems integration solutions

Capital investments

Steering Committee & External Advisory Board

ARIES Addresses Three Energy System Technical Challenges

1

Variability in the **physical size** of new energy technologies being added to energy system

2

Securely controlling **large numbers** (millions to tens of millions) of interconnected devices

3

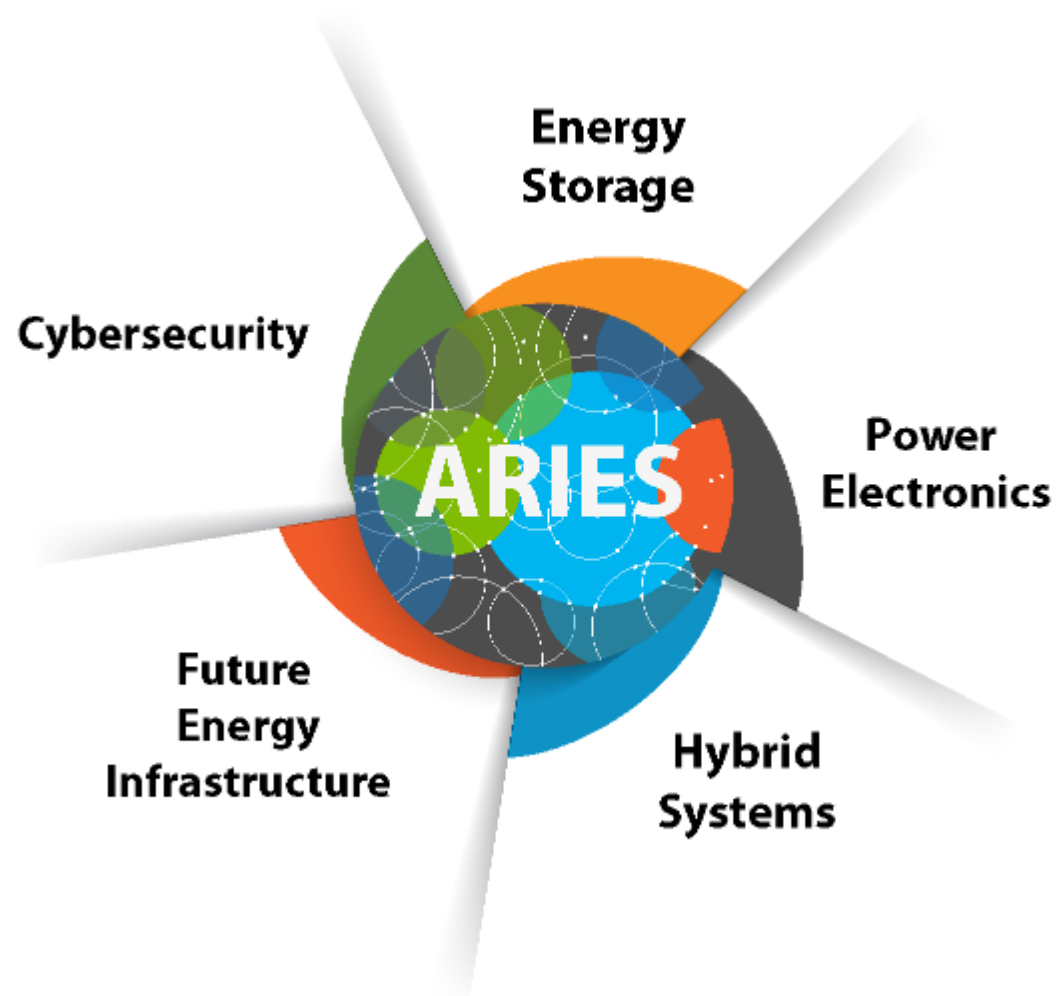
Integrating **multiple diverse technologies** that have not previously worked together








Supporting the transition to a decarbonized energy system:

a safe environment to prove things out, to avoid introducing significant risk, vulnerability, and expense to the providers, customers, and other stakeholders.

Five ARIES Research Areas for Solutions



-  **Energy storage** to balance variable renewable generation and demand
-  **Power electronics** to control and integrate rapidly increasing electronics-based technologies
-  **Hybridization** to achieve enhanced coordinated capabilities beyond isolated technologies
-  **Infrastructure** to adapt existing energy infrastructure for safety, monitoring, and controls
-  **Cybersecurity** to secure operations to prevent disruption, damage, and loss of functionality.

ARIES Steering Committee

DOE

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Acting Principal Deputy Assistant Secretary for the Office of Energy Efficiency and Renewable Energy

MICHAEL BERUBE

Deputy Assistant Secretary for Sustainable Transportation

CHRISTY COOPER

Acting Deputy Assistant Secretary for Operations

BECCA JONES-ALBERTUS

Acting Deputy Assistant Secretary for Renewable Power

KEVIN LYNN

ARIES Lead & Director Grid Modernization

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Golden Field Office Director

CAROLYN SNYDER

Deputy Assistant Secretary for Energy Efficiency

NREL Team

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Deputy Laboratory Director-Science & Technology

JOHNEY GREEN

Associate Laboratory Director, Mechanical and Thermal Engineering Sciences

JUAN TORRES

Associate Laboratory Director, Energy Systems Integration

JENNIFER KURTZ

ARIES Research Director & Center Director

JERRY DAVIS

ESIF & ARIES Laboratory Program Manager

JENNIFER PALMER

ARIES Research Advisor & Technical Coordinator



Committee Focus

- **Ultimate oversight** of and **responsibility** for ARIES R&D management, research impact, and financial and business practices.
- Comprised of **EERE** and **NREL** executive leadership.

External Advisory Board Members



Gary Smyth
Executive Director – Retired,
General Motors



Jeffrey Baumgartner
Senior Advisor, Berkshire
Hathaway



Colton Ching
Senior Vice President,
Hawaiian Electric Company



Lauren Faber O'Connor*
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Qcells



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and Environmental Programs,
Department of Homeland
Security



Ron Sega
Representative,
Department of Defense



Emma Stewart*
Independent Advisor



Timothy Unruh
Executive Director, National
Association of Energy Service
Companies



Evan Wolf
Partner, Crowell and
Moring LLP

ARIES Scale

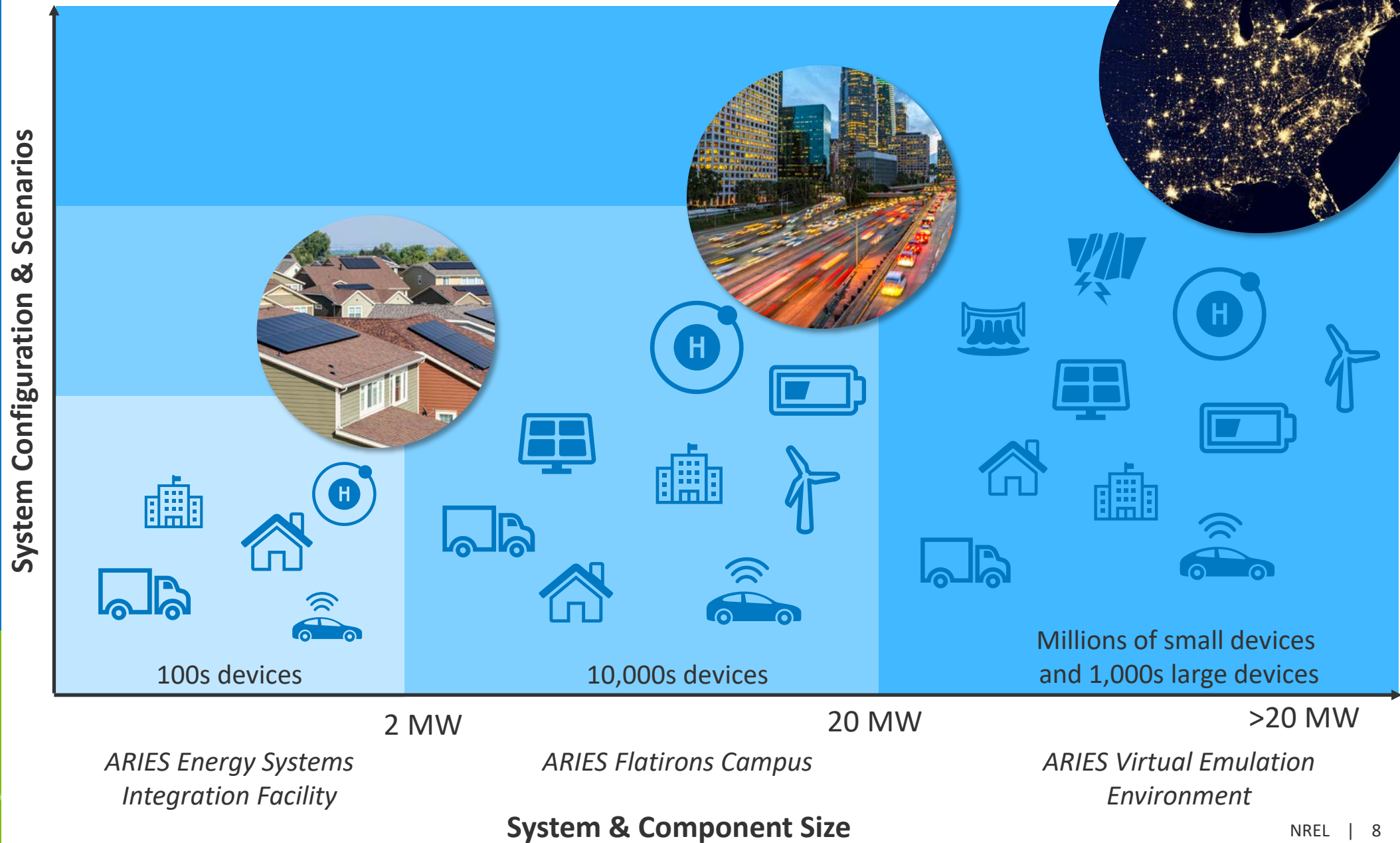
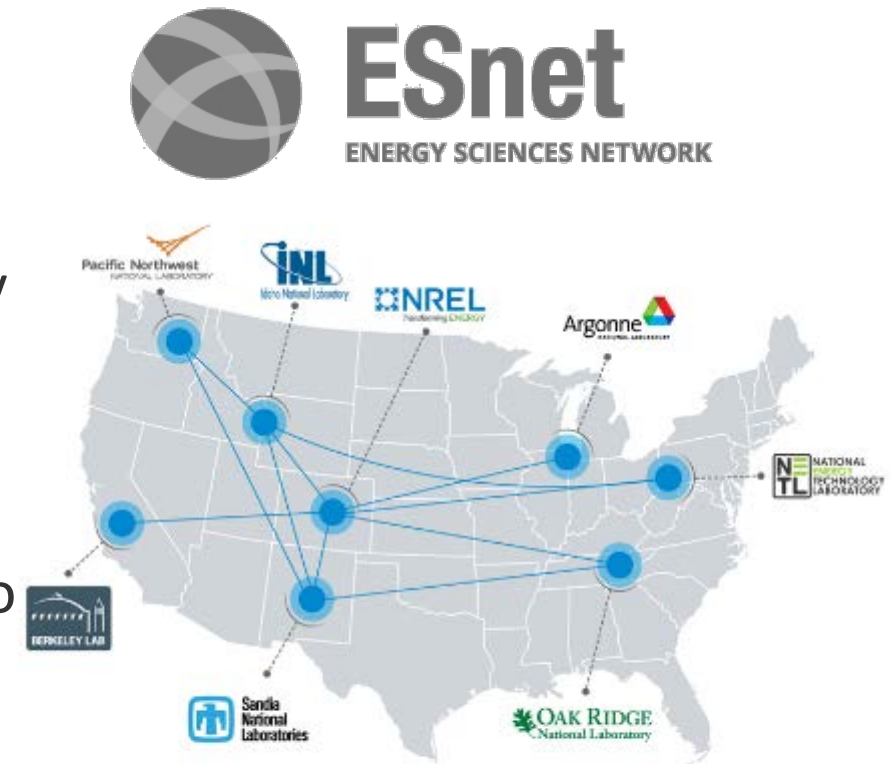


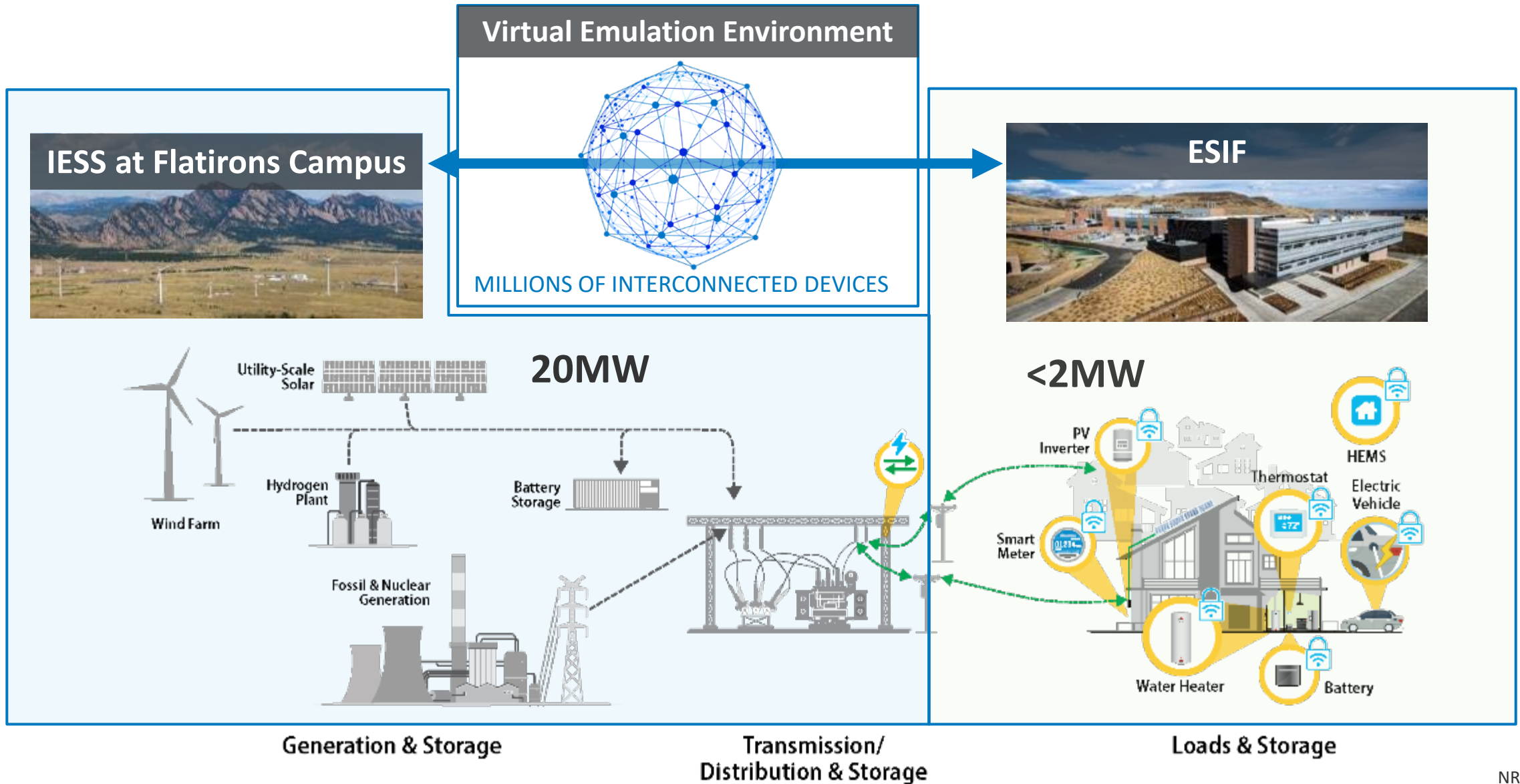
Photo credit: NASA Earth Observatory

Lab-to-Lab Demonstration

- In FY22, for the first time, ESnet-OSCARS was used to integrate energy systems across geographies (PNNL & NREL).
- **INL/NREL Jan 31 demo** integrates nuclear assets at INL and renewable assets at NREL into one experiment. Will explore the complementary interactions between energy storage, nuclear, and various renewable energy technologies.
- Low latency data exchange accelerates grid research by allowing geographically separated assets and scientists to work like they are side-by-side.
- Goal is "SuperLab 2.0." with 7 connected national laboratories.
 - NETL, ORNL, LBNL (2023)
 - Sandia (TBD)



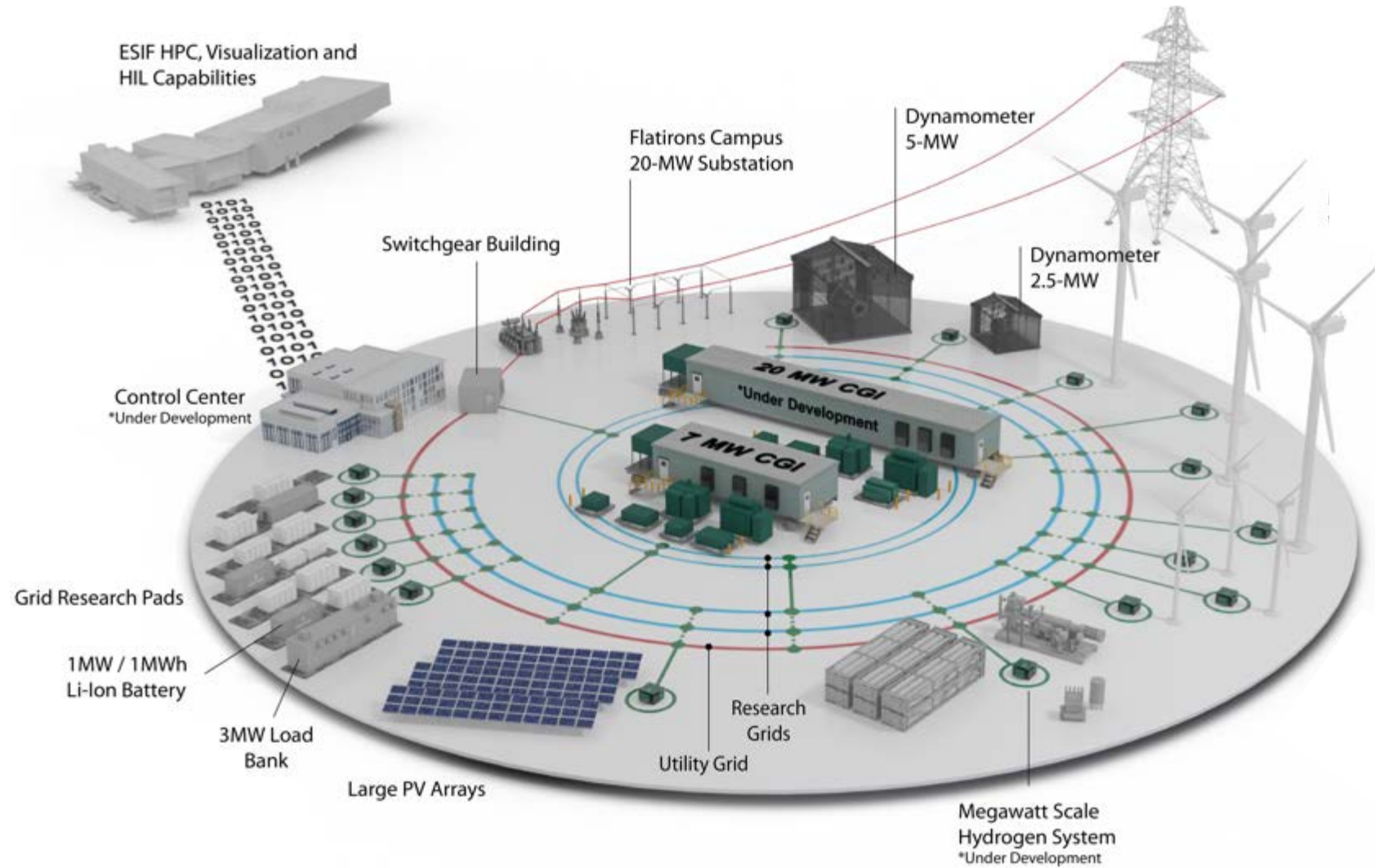
ARIES research platform pillars



ARIES



Flatirons Campus Connections



ARIES RD&D

ARIES RD&D Highlights



Secretary of Energy Launches C2C

\$50M program helping communities meet their clean energy goals using the ARIES research platform



ARIES Heavy-Duty Hydrogen Fueling

Unique fueling system supports high-flow-rate heavy-duty fuel cell electric vehicles and machinery



ARIES Hydrogen Expansion

Creating dynamic hybrid energy capabilities to study hydrogen integration at the MW-scale in collaboration with NEL and Toyota



Clean Energy Cybersecurity Accelerator

Leveraging ARIES Cyber Range to address urgent security gaps

ARIES RD&D Highlights



Grid-Forming Controls

First Type-3 Turbines
Using Grid-Forming
Controls



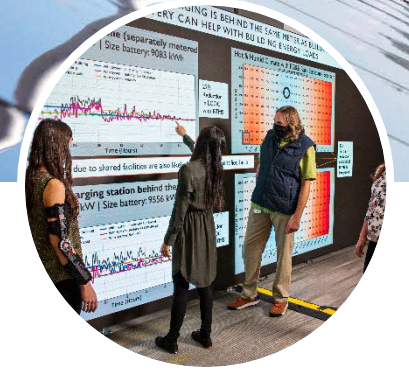
Derisking Energy Solutions for Communities

Validating modeling and
analysis solutions with
community-based data
and requirements



UNIFI Consortium

35 laboratories,
universities and industry
partners developing
inverter specifications



Behind the Meter Storage Project

Optimizing building and
charging loads, energy
storage and renewables
production

An aerial photograph of a large-scale renewable energy project in a dry, open landscape. In the foreground, several white and blue storage containers are visible, with one prominently displaying the 'TOYOTA' logo. To the right, a large array of solar panels is installed on a flat surface. In the background, a tall tower and a wind turbine are visible against a clear blue sky. The overall scene depicts a modern energy infrastructure site.

Thank You

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ARIES

Differentiating Characteristics

- **Infrastructure at scale**, coupled with the R&D expertise (hardware, analysis, and modeling), to remove barriers and introduce new ideas to the market
- **Flexibility** to investigate many, **complex system configurations** integrating real devices and protocols
- An **entire system** (generation, demand, and storage) perspective in a **real-world** context for future energy systems
- **Partnerships** to increase impact and accelerate innovation

