



 **ARIES** 2024
by NREL



Message From External Advisory Board Member

As a member of the external advisory board for Advanced Research on Integrated Energy Systems (ARIES) over the past four years and as a leader in an organization that has closely collaborated with the National Renewable Energy Laboratory (NREL), I am thrilled to witness the evolution of the ARIES research platform. Dallas-Fort Worth Airport is the largest carbon-neutral airport in North America. We have reached a milestone through solid collaboration between NREL and the ARIES research platform, resulting in an 81% reduction in airport emissions from a 2010 baseline.

The collaboration with the NREL team also resulted in the creation of the first operating airport digital twin model that potentially reduces energy consumption and the airport's environmental footprint, creating a win-win-win scenario that benefits the airport, airlines, and surrounding communities. For example, the digital twin project (a first of its kind) demonstrated the potential to reduce 14 million gallons of jet fuel, which equates to approximately \$37 million and 135,000 metric tonnes of carbon dioxide per year. This initiative also supports the airport's resiliency strategy to relieve pressure on the grid during critical periods and prepare for increased scarcity events. NREL's diverse team of experts is transforming how ports, transit hubs, communities, and utilities transition to and adopt renewable energy resources.

Robert Horton, Ph.D., P.E.

Vice President of Environmental Affairs & Sustainability Department

Dallas-Fort Worth International Airport



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ARIES VISION

The Advanced Research on Integrated Energy Systems (ARIES) vision is to validate a broad range of future energy systems and grid modernization scenarios, helping stakeholders accelerate the implementation of energy technologies needed to meet the U.S. Department of Energy's (DOE's) goals for a secure, affordable, and resilient future energy system.

Addressing an Urgent National Need

ARIES accelerates the ability to research and validate innovative solutions for large-scale integrated renewable generation, storage, and increasing demand-side loads—essential technologies to realizing our national energy goals.

Developing an At-Scale Research, Development, and Deployment Platform

ARIES is DOE's advanced research platform for energy systems integration research, validation, and demonstration at a scale that reflects the real challenges faced by industry.

De-Risking Energy Systems

ARIES can replicate real-world scenarios of broad clean energy deployment, allowing users to safely demonstrate their best pathways to reaching local and national energy goals.

Distinguishing a National Asset

ARIES crosses multiple energy sectors, scales, and technologies. It joins together physical and virtual energy assets and enables national labs to combine their expertise and capabilities to address complex energy systems integration challenges.

ARIES FRAMEWORK

Systems-level challenges drive the need for a research platform that can support integrated research, development, and demonstration at scale. ARIES focuses on solving three key challenges by addressing them through our strategic research areas: energy storage, future energy infrastructure, power electronics, cybersecurity, hybrid energy systems, and an emerging research area, industrial energy.

Key Challenges

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

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

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

Research Areas



Energy Storage

to balance variable renewable generation and loads



Future Energy Infrastructure

to adapt existing energy infrastructure for safety, monitoring, and controls



Power Electronics

to control and integrate rapidly increasing electronics-based technologies



Cybersecurity

to secure operations to prevent disruptions, damage, and loss of functionality



Hybrid Energy Systems

to achieve enhanced, coordinated capabilities beyond isolated technologies



Industrial Energy

to optimize energy solutions

2024 Impact

In 2024, ARIES made significant progress to address the three challenges and advance the platform's strategic research areas by:

Increasing focus on the **impact of grid edge devices** (e.g., buildings, vehicle infrastructure, electrolyzers, and communities) for control optimization, cost reduction, and improved performance on the grid.

Addressing utility deployment challenges by using ARIES to validate technology and cybersecurity solutions for battery/hydrogen storage, photovoltaic inverters, and operational technology cloud services.

Integrating new technologies (e.g., geothermal hybrid plant, megawatt-scale grid-forming inverters) for grid services and performance.

2024 NUMBERS AT A GLANCE

153 multidisciplinary research projects

19 DOE offices engaged

\$49.6 million in FY 2024-funded research

38 active partners

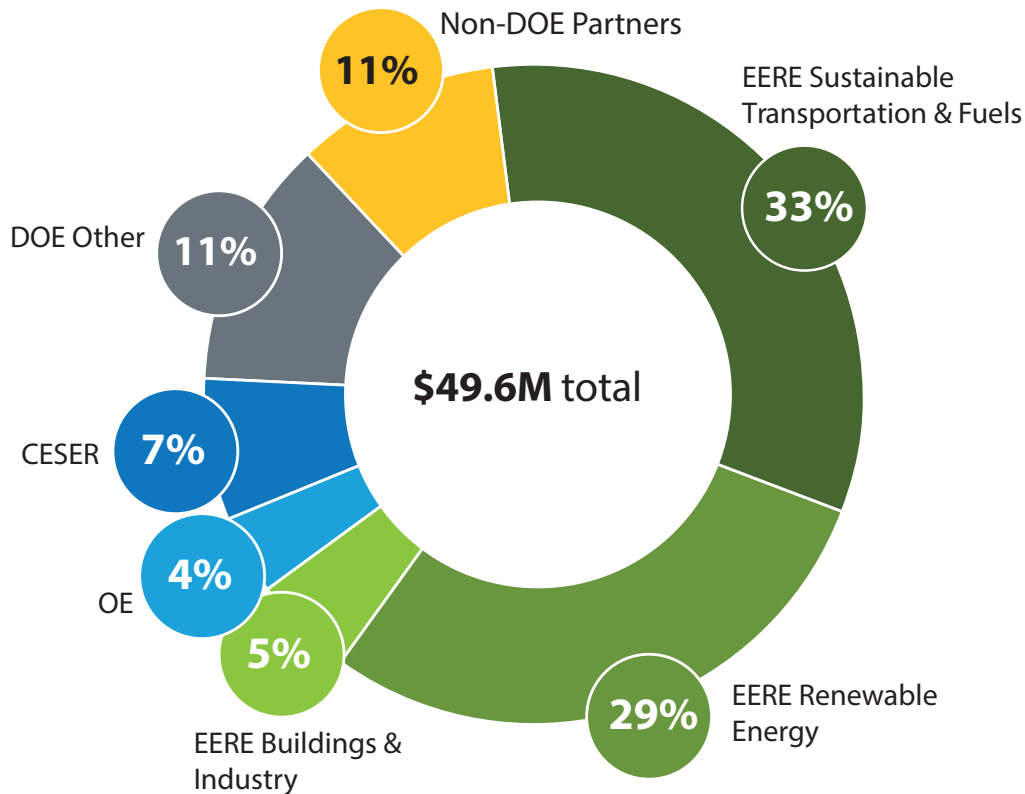
Learn more about the National Renewable Energy Laboratory (NREL) facilities that make ARIES research possible:

Advanced Computing

Energy Systems Integration Facility

Stewardship Summary





This chart represents the funding percentages from DOE offices and partners.










DOE Office and Program List of Acronyms

- BTO** Building Technologies Office
- CESER** Office of Cybersecurity, Energy Security, and Emergency Response
- DOE** U.S. Department of Energy
- EERE** Office of Energy Efficiency and Renewable Energy
- FECM** Office of Fossil Energy and Carbon Management
- GTO** Geothermal Technologies Office
- HFTO** Hydrogen and Fuel Cell Technologies Office
- NE** Office of Nuclear Energy
- OCIO** Office of the Chief Information Officer
- OE** Office of Electricity
- SC** Office of Science
- SETO** Solar Energy Technologies Office
- VTO** Vehicle Technologies Office
- WETO** Wind Energy Technologies Office
- WPTO** Water Power Technologies Office







ASSET TECHNOLOGY ICON LEGEND:

Look for these icons throughout the next section:

Technologies

-  Buildings
-  Microgrid
-  Hydrogen
-  Wind
-  Grid
-  Solar
-  Hydro
-  Vehicles
-  Geothermal

Research Areas

-  Hybrid Energy Systems
-  Energy Storage
-  Cybersecurity
-  Future Energy Infrastructure
-  Power Electronics
-  Industrial Energy

RESEARCH IMPACTS

INTEGRATING NEW TECHNOLOGIES



ARIES Launches Digital Twin Environment for Hybrid Geothermal Power Plants

Sponsor: **GTO**

Researchers are developing a geothermal digital twin in a real-time simulation environment named Ezergetic to study the performance of geothermal hybrid power plants, including their capability to provide grid services, flexibility, and resilience. Through ARIES, the digital twin can be integrated with other power generation and energy storage technologies, as well as the electric grid, to evaluate the dynamic operation and to de-risk the commercial deployment of geothermal hybrid systems.



Geothermal



Hybrid Energy Systems

ARIES Team Debuts One-Megawatt Capability for Evaluating Grid-Forming Inverters—the Key to 100% Clean Power

Sponsors: **SETO and WETO**

Started in 2022 by DOE and midway through a 5-year effort, the Universal Interoperability for Grid-Forming Inverters (**UNIFI**) Consortium continues to advance the development of grid-forming inverters with a multipronged, multi-institution approach. Among numerous accomplishments and publications, the team established an ARIES 1-megawatt (MW) demonstration platform to study grid-forming inverters, which debuted using inverters from several different manufacturers. The platform is open for vendors to validate operating modes and will help establish uniform requirements for interconnection and interoperability, a key to 100% clean power systems. Learn more about UNIFI's impact and outreach at <https://unificonsortium.org/>.



Grid



Solar



Wind



Power Electronics





SuperLab Showcase: Connecting Five Geographically Dispersed Labs' Assets to Address the Challenges of Hybrid Energy Systems and Grid Complexity

Sponsors: **OE, SC, FECM**

The latest SuperLab experiment demonstrated how both current and future energy resources can seamlessly work together in a balanced energy system, representing power systems of today and the near future. The experiment combined 25 assets from 5 national laboratories—including renewable generation, storage, grid edge resources, a gas turbine, and a nuclear small module reactor simulator—to determine how this plausible part-renewable system would fare during a major system fault. The demonstration was successful, furthering confidence in DOE's unique capability to run remote experiments centered at ARIES.



Hydrogen



Storage



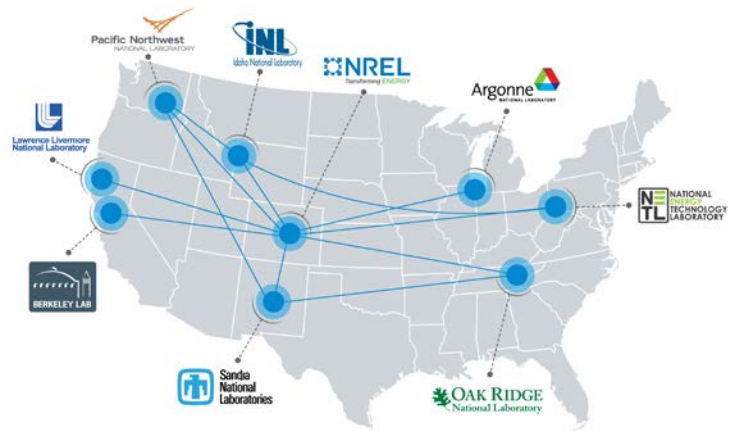
Future Energy Infrastructure



Cybersecurity



Hybrid Energy Systems



ARIES Researchers Identify and Mitigate Cyber Risks of Clean Energy for Disadvantaged Communities

Sponsor: **CESER**

Researchers are working directly with communities and energy device manufacturers to understand and mitigate the cybersecurity threats affecting disadvantaged communities. In phase one of the project, the researchers gathered input and designed methodologies to address cybersecurity unknowns. They will apply their findings to the [ARIES Cyber Range](#), allowing future projects to more realistically emulate risks for disadvantaged communities. The results will also be translated into a training course and analysis tool for utilities and other stakeholders.



Buildings



Grid



Cybersecurity



Flexible Charging Unifies the Grid and Transportation Sectors to Prepare for EVs at Scale

Sponsor: **VTO**

To assess the charging demand of future electric vehicle (EV) adoption and determine the corresponding grid impacts, the NREL-led FUSE (Flexible charging to Unify the grid and transportation Sectors for EVs at scale) project team for the EVs@Scale Consortium is leveraging ARIES to conduct at-scale travel charging analyses and demonstrations of smart charge management and vehicle-grid integration strategies. This year, the team refined in-house controls, charging simulations, and a hardware test bed, which will then be used to demonstrate the real-world benefits of grid-transportation coordination.



Vehicles



Grid



Storage



Future Energy Infrastructure



ARIES Models and Simulates Homes Providing Flexibility to the Grid

Sponsor: **BTO**

Portland General Electric (PGE) is interested in aggregating heating, ventilating, and air-conditioning systems, water heaters, battery energy storage, and EVs to supply flexibility to the grid in the DOE Connected Communities project [SmartGrid Asset Load Management & Optimized Neighborhood \(SALMON\)](#). To evaluate the controls that PGE will use for approximately 580 buildings, researchers modeled homes and developed a real-time simulation environment using ARIES. Next, they will deploy a commercial distributed energy resource management system at NREL with PGE's simulated network, showing how regular devices can amount to megawatts of grid flexibility.



Buildings



Grid



Hybrid Systems

High-Power Vehicle Charging Hub Debuts With Open-Source Charge Management System

Sponsor: **VTO**

In the NREL-led, multi-lab project High-Power Electric Vehicle Charging Hub Integration Platform (eCHIP), researchers used new ARIES hardware to establish a hub for high-power charging and validate a first-of-its-kind technology with that hub: an open-source management system for optimizing charging time, cost, and energy sharing. The project connected DC chargers with battery energy storage, solar photovoltaics (PV), and building devices, and then showed that the resources can be orchestrated together for common charging and grid objectives. This work is part of the EVs@Scale Consortium and will enable a new generation of high-power charging experiments.

[Read the recent report.](#)



Vehicles



Grid



Storage



Future Energy Infrastructure

Partners and Projects Queue Up for Megawatt Electrolysis, Storage, and Fuel Cell Capability

Sponsor: **HFTO**

The recently commissioned megawatt-scale ARIES hydrogen capability is now actively being used for research projects, including dynamic response and hybrid power plants. A flagship use case for the new capability saw the 1.25-MW electrolyzer connected to a solar array, wind turbines, and the campus grid controller, such that the electrolyzer produced hydrogen dynamically to match the excess renewable energy production. The demonstration of advanced grid coupling of hydrogen technologies, including long-duration energy storage and low-temperature electrolysis, is a top priority to ultimately meet DOE's [Hydrogen Shot](#) goals of reducing the levelized cost of hydrogen.



Fast-Fueling Protocol Validated With ARIES, Ready for Heavy-Duty Hydrogen Vehicles

Sponsor: **HFTO**

Researchers have used ARIES hydrogen fueling infrastructure to implement and validate an important fast-fueling protocol and develop a supporting heavy-duty [hydrogen filling simulation model](#). The protocol is at the center of the heavy-duty hydrogen vehicle industry, and ARIES has made it possible for the first time to assess the protocol in real-world operations using industry-provided components. With industry partner Shell, researchers also demonstrated wireless communications between a vehicle and the station during fueling—another solution on the horizon for fast-fueling infrastructure.



ADDRESSING UTILITY DEPLOYMENT CHALLENGES



Utility's Hybrid Battery-Hydrogen Microgrid De-Risked With ARIES

Sponsor: **Energy Vault**

NREL researchers partnered with Energy Vault to deploy a 3.45-MW battery inverter, 3/3.3-MWh battery energy storage system, and a 1.6-MW fuel cell inverter, showing how these resources work in tandem to support microgrid operation during public safety power system shutdowns. The project team ran multiple at-scale experiments using ARIES medium-voltage equipment, and after successful evaluations, this equipment was moved to Calistoga, California, for field deployment. Results showed that the battery inverter and fuel cell inverter operated as designed during the lab evaluation, giving Energy Vault and Pacific Gas and Electric Company (observers) the confidence to replace 10 MW of diesel generation with this unique hybrid battery and hydrogen asset.



Hydrogen



Microgrid



Storage



Cybersecurity Researchers Use ARIES Cyber Range to Evaluate Cloud Data Feasibility for Complex Energy Systems Capability

Sponsor: **OCIO**

To help utilities feel confident about cloud data from a resilience and cybersecurity perspective, an ARIES team is evaluating cloud-based energy systems management in the project CloudZero. Within the [ARIES Cyber Range](#), they have federated the cloud by installing multiple cloud environments in a single computing environment. This allows partners to try their use cases, with several already underway, including load forecasting, system failover/recovery, and bulk electric system reliability.

Learn more about how the [ARIES Cyber Range is being used to secure the cloud for energy systems](#).



Cybersecurity



Future Energy Infrastructure

Florida Utility's Solar Ambitions Drive ARIES Experiments in Grid Stability of Renewable Energy

Sponsor: **SETO**

With an expected solar PV capacity of 25 gigawatts (GW) by 2032, Florida Power & Light has good reason to reassess the electrical stability of its future power system, and ARIES offers the unique capabilities to do so. Researchers used ARIES to validate a common solar inverter model against its real electrical response at the microsecond timescale. This ensures that the utility is using a trustable model and will not encounter unexpected instabilities. Similar projects with industry partners to prevent instabilities by demonstrating diverse control interactions between renewable energy assets are just getting underway.



Solar



Grid



Power Electronics

CAPABILITIES AND BUILDOUTS

ARIES comprises three pillars networked together to provide an interconnected and scalable research platform:

- The [Energy Systems Integration Facility](#) (ESIF) offers advanced research capabilities supporting experiments with up to hundreds of research devices, power levels up to 2 MW, and voltage levels up to 13.2 kilovolts (kV).
- The [Flatirons Campus](#) provides extensive hardware and simulation resources supporting experiments for thousands of research devices, power levels up to 20 MW, and voltage levels up to 34.5 kV.
- The Virtual Emulation Environment (VEE) is a sophisticated digital platform that can incorporate physical assets from the ESIF and Flatirons Campus to emulate millions of devices at any utility power and voltage level and from local to national scales.

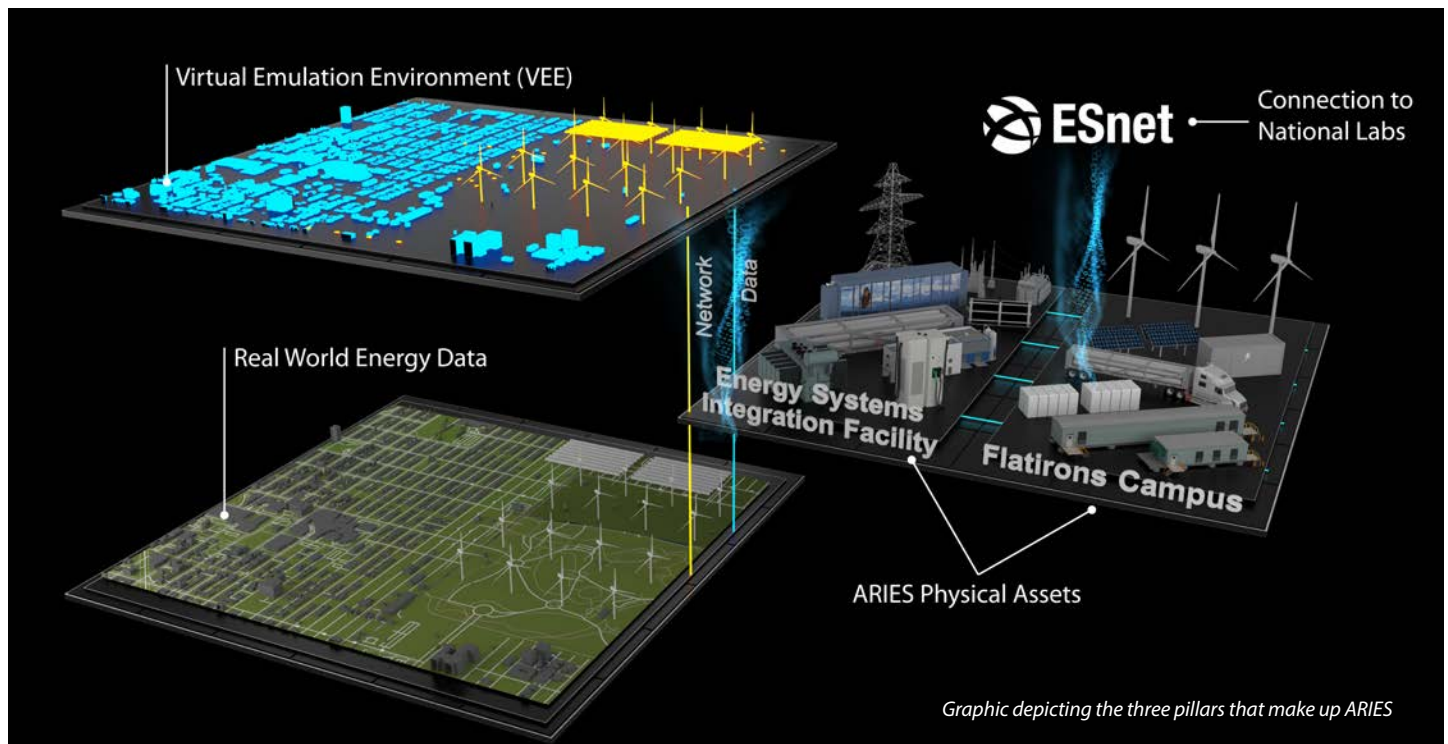
Flatirons Campus

New Control Center Facility for Data Processing Almost Finished

Developed in collaboration with NREL capital investment
A 9,000-ft², two-story control center will serve as the future data processing hub for microgrids and the controllable grid interface (CGI). The building's completion is expected in early 2025.

Quadrupled Capacity of CGI Increases Volume of Projects

Developed in collaboration with WETO, WPTO, SETO
The CGI gives ARIES the ability to customize power flow and replicate real grids, and now it has expanded from 7 to 27 megavolt-amperes, among other improvements. The enhanced interface has been used in several projects, including its inaugural application: a dispatchable hybrid energy storage-synchronous condenser system.



Graphic depicting the three pillars that make up ARIES

Advanced Converters Are Prototyped Within New Medium-Voltage Platform

Developed in collaboration with SETO and WETO

The ARIES power electronics grid interface has added a medium-voltage platform that is being used to demonstrate back-to-back converters, a lighter and more versatile type of grid transformer. “If we can do direct medium-voltage conversion, then we effectively can get rid of the transformer altogether.” —Barry Mather

Direct Solar-to-DC Power Experiments Soon Possible With 2-MW PV Array

Developed in collaboration with NREL capital investment, SETO

ARIES is commissioning a 2-MW solar PV array that will tie to direct current assets like the hydrogen electrolyzer. This will be useful for studying novel hybrid configurations, black starts, EV fast charging, and more.

Low-Temperature Electrolysis Integrated With Grid and Renewables Is Now Possible at Realistic Scale

Developed in collaboration with HFTO, NREL capital investment

With the successful commissioning and installation of a 1.25-MW electrolyzer, experiments to renewably generate hydrogen gas are already producing results. Once other assets are in place, the electrolyzer will operate directly with solar PV, wind turbines, and storage tanks for fully integrated hydrogen experiments.

High-Power Charging to Address Mobility and Storage Opportunities

Developed in collaboration with VTO, NREL capital investment

Construction is underway for a high-power EV charging station where partners will evaluate megawatt-scale vehicle-grid designs. This capability will add to industry’s knowledge around how behind-the-meter assets can provide storage, grid flexibility, and more.

ARIES Wind Research Will Enter New Era With 3.4-MW Turbine

Developed in collaboration with WETO, NREL capital investment

A 3.4-MW turbine with a tip height of 151 meters is coming to ARIES and will support research spanning industrial energy, grid integration, hybrid power plants, wind energy-specific research and development (R&D), and much more. Alongside the current ARIES wind turbines, the incoming turbine will bring modern technology for forthcoming wind R&D.

Underground Hydrogen Storage Will Carve Out New Energy Pathways

Developed in collaboration with HFTO

Natural gas blending, molecule building, and long-term energy storage: These are some of the new directions that a 10-ton hydrogen storage cavern in lined rock shaft will offer ARIES and its partners. Designs are complete and approvals are pending for this capability, which will launch the next chapter in hydrogen energy research.

ESIF

New Energy Security and Resilience Lab Opens, Becomes Operations Center for the ARIES Cyber Range

Developed in collaboration with NREL capital investment

A new laboratory is the security and resilience headquarters for ARIES. It leverages the [ARIES Cyber Range](#) to perform evidenced-based analyses that virtualize, emulate, and visualize grids under various disruption scenarios. The lab is customized for easy access by utilities, national labs, technology developers, and others to evaluate the energy security and resilience of our evolving energy systems using ARIES.

Utility Test Bed Supports Third-Party Software for Distributed Grid Management

Developed in collaboration with OE, NREL capital investment

Utilities rely on the ARIES Advanced Distribution Management System (ADMS) Test Bed to model and simulate their operations, and now they can co-simulate scenarios using commercial vendor technologies. The latest additions to the ADMS Test Bed allow integration with third-party software for microgrids, virtual power plants, and facility energy management. It will soon also simulate network communications for complex, many-device systems.

VEE

SuperLab Mobilizes Remote Resources at Five National Labs

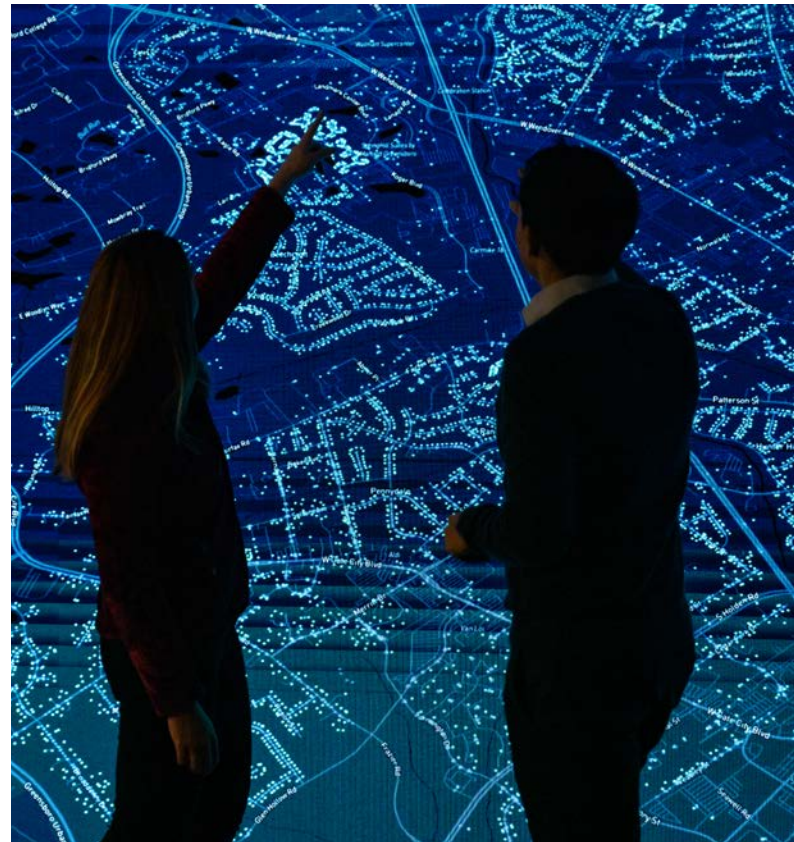
Developed in collaboration with OE, SC, EERE, FECM, and NE
Far from NREL's campus, a diverse set of resources contributes to ARIES: a nuclear simulator in Idaho, a microgrid battery in New Mexico, and many more assets throughout the United States. This is the SuperLab, a real-time link between lab capabilities to tackle the greatest national challenges. This year the labs demonstrated how the SuperLab can study grid disturbances by triggering resources to come online and recover power system stability.

ARIES Claims Largest R&D Cluster of Digital Real-Time Simulators Globally

Developed in collaboration with NREL capital investment
Digital real-time simulators are essential to emulating power grids at any scale—from microgrids to large, interconnected regional systems. NREL now operates 24 clusters capable of real-time emulation across a spectrum of scenarios, from microgrid “building blocks” to regional-level transmission systems, such as the Western Interconnection. These clusters are set to demonstrate interactions among thousands of power devices, showcasing robust, scalable simulation capacity for diverse grid configurations in FY 2025.

ARIES Cyber Range Adds New Computing and Emulation Capabilities

Developed in collaboration with CESER and EERE
The [ARIES Cyber Range](#)—NREL's innovative cyber-physical modeling and simulation platform for deploying high-fidelity energy system environments at scale—has added more computing power and a prototype emulation library for streamlined system modeling. These additions all contribute to a cyber-physical platform that is faster to configure, easier to deploy, and more powerful for supporting the increasing scale and complexity of a rapidly evolving and more digital energy future.



ENGAGEMENT AND OUTREACH HIGHLIGHTS



56 industry representatives

interviewed to inform the ARIES industrial energy research and capital investment plan



55 ARIES VIP tours

given to DOE offices, government officials, and partners (industry, utilities, other labs)



17 conferences, workshops, summits

with ARIES keynote speakers, panelists, or delegates



15 members of the ARIES external advisory board who meet biannually to give utility, industry, academic, and governmental perspectives



2 live demos

of ARIES capabilities



8 new strategic partners

added from 2023



18 new projects

with partners started in FY 2024



2 standards developed



1 first-place award

at an Electric Power Research Institute competition

Research Outcomes

14 *peer-reviewed journal articles*

1 *high-impact publication*

37 *conference papers*

11 *technical reports*

16 *software records*

3 *records of invention*

1 *new patent*



LOOKING AHEAD

Approaching 5 years of uniquely impactful research, ARIES is ramping up to take on more work than ever. Demand for our capabilities is growing—evidenced by the number and diversity of new projects—and those projects have an edge of urgency: They are about adapting to extreme weather, bolstering cybersecurity, and addressing the needs of energy-intensive industrial applications.

We are meeting increased demand with exactly what our partners need: higher power capacity, a wider variety of resources, more complex interconnections, precise models, and expert knowledge. With these ingredients, and the caliber of projects in the queue, it is truly exciting to see what's next. Some of the most exciting examples are our support for smaller communities.

Community Clean Energy Goals

Through the [DOE Clean Energy to Communities \(C2C\) program](#), local groups get assistance with their clean energy goals, and ARIES is often central to discovering their approach. Two in-depth partnerships are evaluating renewable generation in remote Sitka, Alaska, and Molokai, Hawaii, while Colorado Springs, Colorado, is leveraging ARIES for microgrid and EV integration. Another cohort selection is underway.

Microgrid Development in Underserved and Indigenous Areas

ARIES will support seven microgrid projects as part of an [OE award to support microgrid solutions](#) in underserved and indigenous communities. These projects will include workforce training, vendor-agnostic controllers, and software standardization—all important directions to strengthen resilience and access to replicable microgrid solutions in communities that are least equipped.

Threat-Informed Operational Collaboration and Collective Defense

The DOE [Energy Threat Analysis Center \(ETAC\)](#) convenes experts from the federal government, the U.S. energy sector, and the national laboratories to secure critical infrastructure against threats. Using the [ARIES Cyber Range](#), NREL researchers will integrate hardware-in-the-loop assets with emulated reference architecture environments to strengthen the collective defense, response, and resilience of the U.S. energy sector.

[ETAC](#) leverages the range to quantify power system cybersecurity and resilience metrics across multilayered architectures surrounding cyber, physical, and human factors.

Rental Fleet Electrification Demonstration

ARIES will be used to emulate a fleet of electric rental cars in the project [Athena ZEV](#), which aims to help airports electrify their infrastructure. The demonstration will establish an integrated research environment to validate rental car charging scenarios with real hardware and emulated traffic flow along with the integration of solar and storage. Partners within the Athena project and beyond will be able to apply the setup and findings to their own zero-emissions efforts to prove out technology before it is deployed.

NREL works with organizations large and small. You can partner with ARIES to de-risk technology solutions for a secure, affordable, and resilient future energy system. For opportunities to work with us, watch the [ARIES webpage](#) or email us at ARIES@nrel.gov to discuss your project.

MESSAGE FROM ARIES LEADERSHIP TEAM MEMBER



When ARIES was launched in 2020, we had a strong vision and purpose for this research platform—to study energy solutions at a large scale. Since then, a steady growth in research and capital investment has brought new hardware and expanded abilities to ARIES. Remarkably, it is a place where such distinct systems as quantum computing, demand side for buildings and transportation, and hydropower emulation, are all contributing to the same integrated energy systems research platform.

As we lay connections between assets new and old, the vision we first had of a complex energy system research platform that makes energy more available, affordable, and resilient, feels much closer. We can use the platform to validate solutions for modernizing our energy infrastructure with cutting-edge hybrid power plants, million-node distribution management, and integrated demands such as in energy-intensive industries like data centers. More than before, we can replicate the opportunities ahead for energy systems, and we are settling into that vision with a host of exciting projects and new partners.

Jennifer Kurtz, ARIES Research Director

ADVISORY COMMITTEES

ARIES Steering Committee

The ARIES steering committee comprises DOE EERE and NREL executive leadership. This committee meets biannually and has oversight of and responsibility for ARIES R&D management, research impacts, and financial and business practices.

Steering Committee Members

U.S. Department of Energy

- **Alejandro Moreno**, Associate Principal Deputy Assistant Secretary for the Office of Energy Efficiency and Renewable Energy
- **Michael Berube**, Deputy Assistant Secretary for Sustainable Transportation and Fuels
- **Christy Cooper**, Deputy Assistant Secretary for Operations
- **Becca Jones-Albertus**, Acting Deputy Assistant Secretary for Renewable Energy
- **Marlys Kinsey**, Acting Director of the Golden Field Office
- **Kevin Lynn**, ARIES Lead and Director of Grid Modernization
- **Carolyn Snyder**, Deputy Assistant Secretary for Buildings and Industry

NREL ARIES Team

- **Peter Green**, Deputy Laboratory Director, Science and Technology
- **Johney Green**, Associate Laboratory Director
- **Juan Torres**, Associate Laboratory Director
- **Jennifer Kurtz**, ARIES Research Director and Center Director
- **Jerry Davis**, ESIF and ARIES Laboratory Program Manager
- **Rob Hovsapian**, Senior ARIES Research Advisor
- **Matthew Thornton**, Senior ARIES Research Advisor

Special thanks to:

Dane Christensen, Steve Hammond, Jordan Henry, Matt Keyser, Jennifer King, Daniel Laird, Barry Mather, Jibonananda Sanyal, and Josh Schaidle

Laboratory program managers, operations team, communications leads, executive assistants, project managers, partnerships development team, finance leads, and subject matter experts.



ARIES External Advisory Board

The ARIES external advisory board provides an external perspective from industry, academia, and other government agencies/programs to NREL, DOE, and EERE on the research direction; research, development, and demonstration gaps that ARIES should address; and the development and deployment of the ARIES research platform.

External Advisory Board Members

Chair: Gary Smyth

Executive Director, Global R&D Laboratories
General Motors (retired)

Jeffrey Baumgartner

Senior Advisor
Berkshire Hathaway Energy

Colton Ching

Senior Vice President, Planning & Technology
Hawaiian Electric Company

Elizabeth Endler

Chief Scientist
Shell

Lauren Faber O'Connor

Operating Partner
Lowercarbon Capital

Paula R. Glover

President
Alliance to Save Energy

Christopher Herbst

Vice President, Strategic Partnerships and
Innovation
Eaton

Robert Horton

Vice President,
Environmental Affairs & Sustainability
Department
DFW Airport

Alice K. Jackson

Senior Vice President, System Strategy and
Chief Planning Officer
Xcel Energy

Adrienne Lotto

Senior Vice President of Grid Security,
Technical & Operations Services
American Public Power Association

Danielle W. Merfeld

Chief Technology Officer
QCells

Teresa R. Pohlman

Executive Director, Sustainability and
Environmental Programs
U.S. Department of Homeland Security

Ronald M. Segal

Representative
U.S. Department of Defense

Timothy D. Unruh

Executive Director
National Association of Energy Service
Companies

Evan Wolff

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