Supporting U.S. National Security Through Cybersecurity Partnerships

Reliable, uninterrupted access to energy is at the core of U.S. national security. NREL is helping partners achieve cyber-resilient systems across the full spectrum of risk analysis and mitigation.

Energy systems are rapidly evolving, digital technologies are expanding, and new cyber threats are emerging from adversaries that are demonstrating both the intent and capability to exploit the digital systems that underlie our nation's critical energy infrastructure.

At NREL, we're proactively studying these evolutions to understand the challenges they pose and uncover ways to leverage electric grid advancements to achieve more secure, defensible, and reliable systems. Our integrated research bridges the gap between cyber threats and real-world consequences to deliver actionable solutions that reduce cybersecurity risks and help strengthen U.S. national security.

NREL Models Dynamic Energy Systems to Challenge Planned Adversarial Attacks

The **Advanced Research on Integrated Energy Systems (ARIES) Cyber Range** is the U.S. Department of Energy national laboratory complex's leading cyber-physical research platform for energy systems research. Combining electric grid-scale hardware with emulation and simulation approaches, the ARIES Cyber Range can faithfully replicate entire energy systems at relevant scale and complexity—including grid physics and communications—with real-world fidelity to solve the toughest grid security challenges without impacting live systems.

Partnering for Impact

NREL works closely with the largest utilities in the United States to codesign realistic environments and test scenarios. These partnerships ensure that models are grounded in operational reality and that the ARIES Cyber Range remains an ideal environment for testing and evaluating innovative defense strategies for our nation.

Cyber R&D for National Security

NREL supports national security objectives by identifying emerging cybersecurity threats and vulnerabilities, measuring their potential impacts on our nation's energy infrastructure, validating mitigation strategies, and tackling critical mission assurance challenges. By leveraging the ARIES Cyber Range, NREL advances the cybersecurity of energy systems—from research to reality.

Vulnerability Assessments

As new technologies are integrated with the grid, supply chains expand, and interdependencies change, new risks emerge. We evaluate energy systems and devices to identify key weaknesses that could be exploited by adversaries.

Threat Analysis

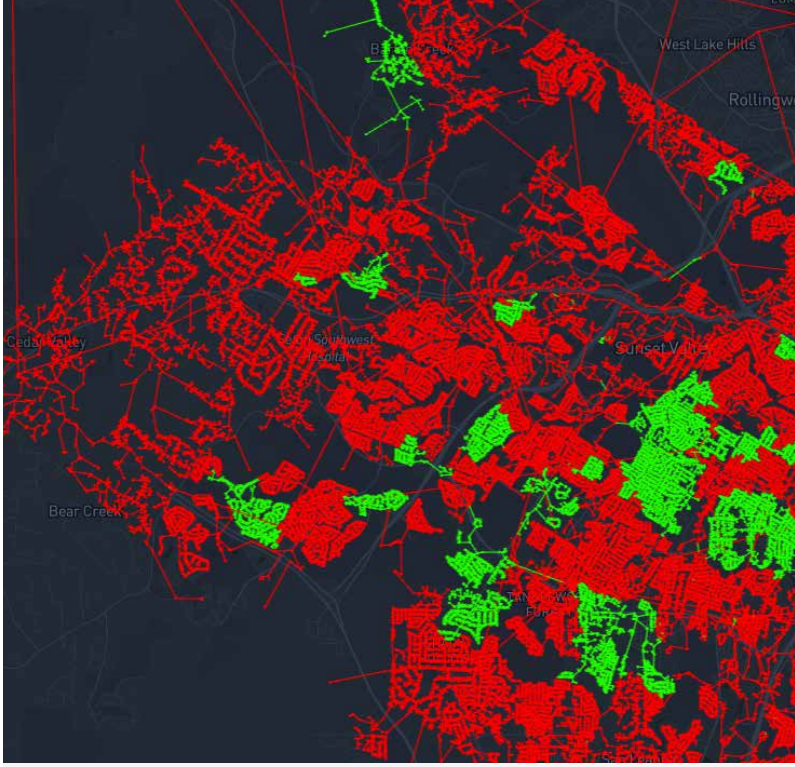
Effectively mitigating risks starts with understanding threats. NREL's cybersecurity threat analysis focuses on characterizing and assessing threats to U.S. critical energy infrastructure through cyber-physical experimentation and analysis. We:

- Study emerging threats.
- Model adversarial campaigns across information technology and operational technology infrastructures to assess cascading impacts at the local and regional levels.
- Analyze cyber-physical interactions to identify vulnerabilities, interdependencies, and operational risks.

Mission Assurance

Using insights gained from vulnerability assessments and threat analysis, NREL assists partners in enhancing mission assurance across homeland and defense-critical environments. We:

- Assess the efficacy of defensive technologies, architectures, and operational playbooks.
- Develop and validate hunt guides and mitigation strategies through iterative testing and evaluation.
- Analyze the consequences of successful attacks and the associated mission impacts.
- Facilitate tabletop and operational exercises to improve coordination among stakeholders.



Model of electric transmission and distribution in Austin, Texas.
Visualization by NREL

Integrated Modeling for Any Hazard

NREL is uniting its capabilities to establish a national platform that helps utilities and government agencies tackle the combined effects of cyberattacks, physical threats, and natural hazards. Our advanced experimentation platform recreates these intertwined threats, so we can develop and deliver tailored security and resilience solutions for any system, at any scale.

Partner With Us

NREL offers public and private partners the opportunity to leverage our research expertise and state-of-the-art capabilities to advance strategic national security priorities and unique mission requirements.

To get started, contact NREL's cybersecurity research center director: Jordan.Henry@nrel.gov.

Cover image: *Photo by Gregory Cooper, NREL 97262*

NREL

15013 Denver West Parkway, Golden, CO
80401 303-275-3000 • www.nrel.gov

NREL prints on paper that contains recycled content.

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Operated under Contract No. DE-AC36-08GO28308

NREL/FS-6A42-95699 • July 2025