

Reducing Current and Future Risks to Energy Security

As global communities transition to clean energy technologies, the threat landscape for energy security is more complex than ever before. While broad adoption of clean energy technologies has progressed across the world, the National Renewable Energy Laboratory (NREL) has been researching how to reduce risks and the value renewable energy technologies bring to improved energy security, today and decades into the future. Continuing adoption of technologies to meet clean energy and climate mitigation goals requires consideration of energy security, making NREL's risk reduction and mitigation research increasingly important.

NREL's growing **strategic energy security (SES) portfolio** focuses on securing clean energy systems against disruptive events by informing policies, investment, and design through decision support, analysis, modeling and simulation, technology development, and fundamental science and research. The portfolio covers the threat-to-consequence arc of potential disruptions within resource extraction, manufacturing, supply chains, affordability, energy justice, and energy portfolio planning.

NREL's Energy Security Capabilities

NREL's capabilities span the pillars of energy security, touching on fuel availability, affordability, accessibility, sustainability, and acceptability, as shown in Figure 1. NREL's researchers provide energy security analyses of global developments, as well as sensitive evaluations of the potential consequences of realistic threat scenarios to the U.S. power grid and other critical infrastructure. Supply change challenges, such as global access to critical minerals and components for new energy technologies can be disrupted by conflict, great power politics, or social unrest, while global plans for increased clean energy adoption creates heightened competition for scarce resources. NREL helps partners reduce such risks by highlighting mitigation strategies for consideration and implementation.

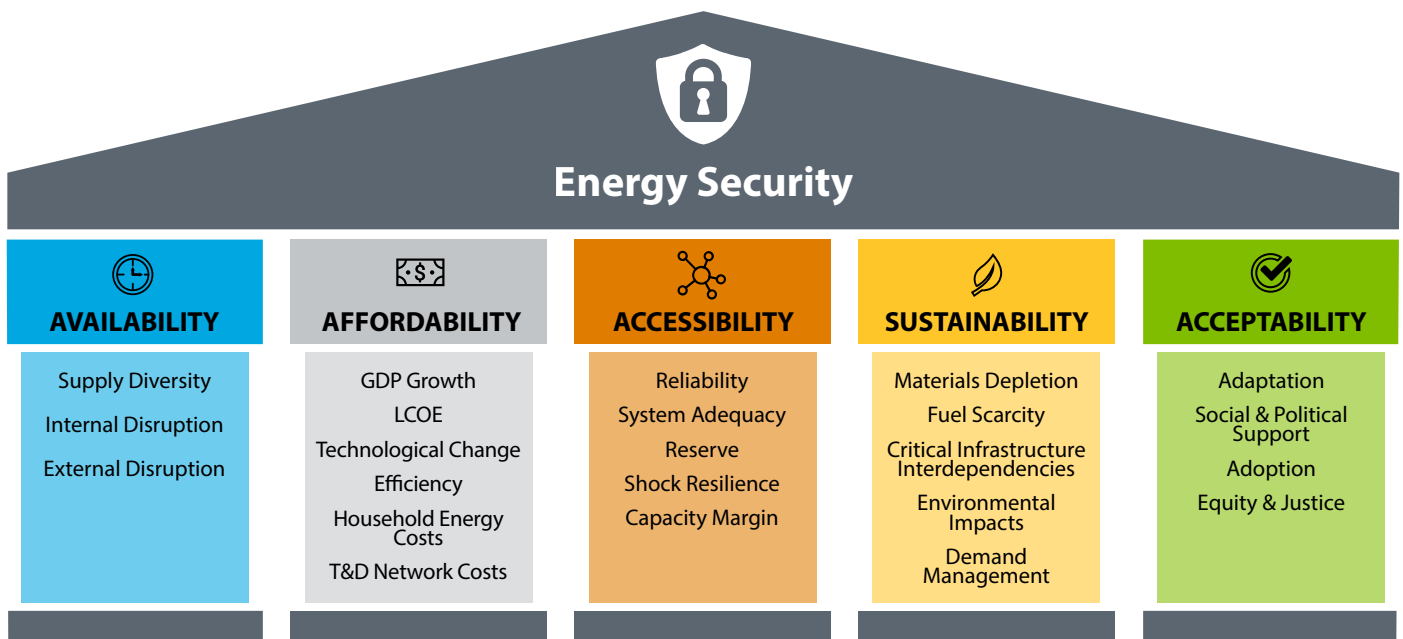


Figure 1. Pillars of Energy Security, graphic modified from Cox, E. 2012.

Supporting Global Strategic Energy Security

With funding from the U.S. Department of Interior, NREL has supported **baseline energy reports and energy security plans** that assist leaders in territories, such as Guam and American Samoa, to help prioritize key vulnerabilities and mitigation options.

NREL has supported **Ukraine** with options for rebuilding, including information on microgrid viability.

NREL is also using its expertise in decarbonization planning to support **Lithuania** in planning for a 100% renewable energy future, simultaneously addressing energy security aspects.

NREL's ongoing research includes a **global supply chain model of critical materials extraction, refining, manufacturing, and recycling, accounting** for increases in demand due to potential expansion of clean energy technology adoption, and potential disruptions and mitigation solutions.



Decision Support

NREL analyses provide insight for national-level decision makers on geopolitical considerations related to a variety of energy pathways. At a more operational level, NREL provides technical assistance on specific technologies, microgrids, and supply chain risks.

To help partners make informed decisions in energy security planning, NREL assesses the potential impacts of large-area, long-duration, disruptive events, including their system-wide consequences and any sectoral interdependencies that may be affected. There are several types of critical interdependencies, including physical, cyber, geographic, and economic. Understanding interdependencies is key to energy security assessments and planning.

Contact

To learn more about NREL's energy security research and capabilities visit our website at www.nrel.gov/security-resilience/strategic-energy-security.html or contact Eliza Hotchkiss and Heidi Applegate.



Energy Security Solutions and Practices

NREL research focuses on developing mitigation solutions that reduce risks and secure energy systems at different scales. These solutions can include resilience, efficiency, adaptation, and policy options. NREL's energy security solutions highlight the value of renewable energy technologies to energy security and how energy security could be improved by reducing supply chain disruption potential, reducing loads through efficiency, and planning for changing future conditions, such as unanticipated migration. These solutions help NREL partners pursue more effective energy investments, and craft more comprehensive policies.



Technology Innovation

NREL has developed tools and models to support energy security analyses and decision making. Researchers are continually integrating crosscutting syntheses of energy security approaches and methodologies into a more comprehensive energy security suite. Efforts include adding different temporal and spatial scales or modeling risks across energy security domains, such as resilience and cybersecurity. Existing tools most relevant to energy security include:

- **Advanced Research on Integrated Energy Systems (ARIES):** ARIES unites research capabilities at multiple scales and across sectors to create a platform at up to the 20-MW scale to understand the full impact of energy systems integration.
- **Lithium-Ion Battery Resource Assessment Model (LIBRA):** LIBRA analyzes electric vehicle types, consumer electronics, and stationary grid storage to understand interconnections between battery manufacturers and market demands while tracking changes throughout the supply chain.
- **Regional Energy Deployment System (ReEDS):** ReEDS simulates the evolution of bulk power systems – energy generation and transmission – from the present day through 2050 and beyond.
- **Probabilistic Resource Adequacy Suite (PRAS):** PRAS performs low-fidelity, high-speed simulations of multiregion power system operations to evaluate the impact of unplanned resource outages and quantify the risk and potential nature of energy supply shortfalls in probabilistic terms.