



NREL is uniquely positioned to provide integrated research, development, and deployment of infrastructure in Alaska and the Circumpolar North.

Arctic Community Engagement: Enhancing Energy Affordability, Resilience, Security

The changing Arctic geopolitical and natural environment presents significant new challenges and opportunities for innovation, economic development, and sustainable energy, as well as enhancing resilience and security in Alaska communities and the greater Arctic region. NREL's Arctic strategy focuses on addressing the impacts of climate change, developing a clean energy and weatherization workforce in the arctic, advancing energy innovation, developing climate appropriate and affordable housing, and ensuring energy security in an era of growing geopolitical threats.

By virtue of Alaska, the United States is an Arctic nation with significant energy, environmental, economic, and security interests in the region. The United States is one of only eight countries with territory above the Arctic Circle and with an Arctic Energy Office. The goal for U.S. policy for this region is a secure and stable Arctic where U.S. interests are safeguarded, the U.S. homeland is protected, and Arctic states work cooperatively to address shared challenges.

Alaska's economy relies on oil and gas revenue but also depends heavily on fisheries, tourism, and mining. Climate change will likely affect each of these revenue streams. Although Alaska's total energy consumption is among the 10 lowest states, its per capita energy consumption is the fourth highest because of its small population, harsh winters, and energy-intensive industries.

Many rural Arctic communities have no grid access and rely on consumer-owned electric cooperatives for their power. These rural power providers primarily use diesel-fueled electricity generators for power production. The price of electricity in rural Alaska and Arctic communities is more than eight times higher than the national average in the continental United States—electricity generated from diesel can exceed \$1 per kilowatt-hour. The reliance on imported fuels for power, transportation, and heat in Arctic communities can create severe economic hardship and uncertainty.

These same communities often contribute the least to greenhouse gas emissions but feel the impacts most acutely. They face receding sea ice and intensifying storms that have accelerated coastal erosion, causing loss of homes, schools, ports, and other public infrastructure; and, in several cases, requiring entire village relocation. These problems will only intensify as approximately 70% of all Arctic infrastructure lies atop near-surface permafrost that will thaw in the next 30 years. Addressing equity in the Arctic necessitates the inclusion of indigenous knowledge in solutions while preparing for the future.

Addressing these challenges necessitates greater pan-Arctic collaboration on energy research and deployment that integrates technical expertise from the world's energy leaders, as well as critical knowledge from circumpolar people.

The Opportunity

The National Renewable Energy Laboratory (NREL) has developed an Arctic Strategy to tackle these complex challenges that builds on its 10-year vision for creating an equitable, clean energy future. Specifically, NREL's Integrated Energy Pathways vision represents a transformed, future integrated energy system that is more affordable, sustainable, secure, and resilient. NREL researchers are leading the nation's transformation from a national electrical grid consisting of large, centralized power generation to a more integrated and flexible system with greater diversity of resource generation, millions of variable distributed resources, dynamic smart loads, and new energy storage. The laboratory recently announced the Advanced Research on Integrated Energy Systems (ARIES) Research Platform that will make it possible to understand the impact of scaling up from hundreds to millions of new devices—such as electric vehicles, renewable generation, hydrogen, energy storage, and grid-interactive efficient buildings—that are being connected to the grid daily.

ARIES provides a compelling opportunity to address energy needs of Alaska and the Arctic, and it provides a strategic platform for building the knowledge, expertise, and workforce to address our global energy needs and the rapid energy transition needed to address climate change. Continued advances in renewable energy and supporting technologies such as energy storage, power electronics, and autonomous controls—along with dramatic cost reductions—offer unique opportunities for locally produced, affordable energy and economic development that can ultimately reduce dependence on imported energy and directly impact local economies.

Just as the Arctic has catalyzed pioneering advances in resource development and energy efficiency technology, from the Trans-Alaska Pipeline to zero-energy Arctic shelters, it serves as a proving ground for solving our global energy challenges. The approaches, technologies, and decision tools developed and proved in this region will apply directly to rural areas and northern climate zones across the United States.

Unique NREL Capabilities

NREL is uniquely positioned to provide integrated research, development, and deployment of infrastructure in Alaska and the circumpolar north. The recently announced NREL and Cold Climate Housing Research Center (CCHRC) partnership leverages NREL's decades-long history of research, development, and deployment of clean energy technologies

with remote Arctic communities. In addition, the expanded collaboration furthers CCHRC's deep partnership with the University of Alaska Fairbanks and NREL's support for resilient U.S. Department of Defense (DOD), Department of Homeland Security (DHS), and port authority installations. All of these capabilities provide a comprehensive approach to building resilient energy systems and connected communities in the Arctic. Although currently focused on Alaska and the Arctic, the results of this research and the applied experience gained by and with Alaskans will be applied to national and global challenges.

Leveraging NREL's integrated energy systems expertise and decades of clean energy research—including experts at the Fairbanks, Alaska-based Cold Climate Housing Research Center—this strategy focuses on three key goals to bring affordable, resilient, secure energy solutions to communities in Alaska and the circumpolar region and across the United States:

Transforming Communities

Fulfilling NREL's Arctic Strategy will require establishing deeper partnerships with Alaska and Arctic entities, including village and regional associations and corporations, to assist with deployment of transformative energy technologies that meet local needs while adapting to climate change, population, infrastructure challenges, and workforce opportunities.

Taking a holistic approach, NREL will collaborate with Arctic communities to advance:

- Affordable energy generation, delivery, and storage options
- Efficient, affordable, and healthy housing and buildings that withstand extreme and changing Arctic conditions and reduce the need for emergency heating options
- Grid-interactive and resilient buildings that incorporate advanced building equipment, building materials, and building transactive controls
- Energy-efficient transportation and industries that incorporate local materials and manufacturing as much as possible.

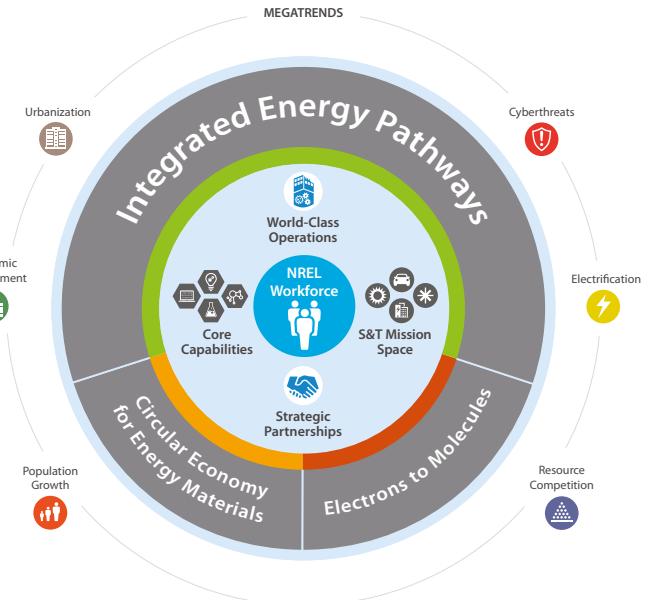
These efforts will advance the novel use of existing technologies, develop new integrated energy–water–food–shelter solutions, maximize efficiency of transportation and supply chains that provide a vital link to outside resources, and enable understanding and use of local waste streams to generate energy or upcycle material into usable goods.

In addition to work with remote communities, NREL will also work with stakeholders in Arctic cities to help advance research in connected communities that maximize grid efficiency and leverage smart technology that supplies vital community services while lowering energy costs for residents.

Strengthening Economies

NREL will partner with Alaskan and Arctic communities to understand and improve options for economic development through:

- New energy-related jobs and economic opportunities
- Local, cyber-secure, digital, and flexible manufacturing systems and infrastructure that can change products on demand based on supply/demand chain interruptions, including health crisis, and emergencies
- Local advanced manufacturing and increased efficiency of remote supply chains
- Workforce training in the emerging clean energy economy.



NREL's 10-Year Plan: A Vision for the Future

The goal of this work is to expand the use of locally produced goods and local labor, increase use of telecommunications, and broaden participation in commercial activity while reducing the cost of energy, food, and housing.

Enhancing Resilience and Security

By leveraging decades of experience working with remote Alaska villages, military bases, and other critical infrastructure installations, NREL will partner with communities and stakeholders to enhance their resilience and security by:

- Deploying island-able microgrids that rely on local energy sources to provide reliable power and reduce fuel imports
- Creating cyber-secure and resilient energy infrastructure where different energy systems provide backup options to each other (for example, power, fuels, and storage) to maintain critical services in the event of emergencies and supply disruptions
- Working with federal agencies such as the DHS and DOD to enhance resiliency in existing ports, critical infrastructure, and military bases.
- Conducting local assessments of regional interdependencies among communities.

Required Infrastructure

To achieve this important strategy, NREL will need to develop an advanced manufacturing and workforce training center at its campus in Fairbanks, Alaska.

Increasing the resilience and security of the built environment to changing Arctic conditions requires an in- or near-Arctic facility and significant cooperation with Arctic communities and research institutions to develop pan-Arctic data sets, decision tools, and best-practice resources.

This facility will also provide the infrastructure needed to offer training programs for on-site, advanced manufacturing and operation of grid-interactive buildings on remote microgrids.

Contact NREL Associate Laboratory Director Johney Green at johney.green@nrel.gov to learn more.