



# NREL in Alaska

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# NREL at a Glance

## 3,702 workforce, including:

- 2,721 regular/limited term
- 503 contingent workers
- 205 postdoctoral researchers
- 179 graduate student interns
- 94 undergraduate student interns

—as of 8/21/2023

## World-class research expertise in:

- Renewable Energy
- Sustainable Transportation & Fuels
- Buildings and Industry
- Energy Systems Integration

## Partnerships with:

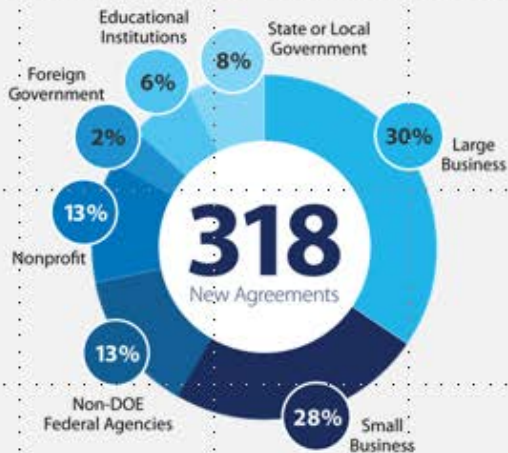
- Industry
- Academia
- Government

**4 campuses** operate as living laboratories



Photo by Werner Slocum, NREL 71582

## More Than 1,000 Active Partnerships in FY 2022

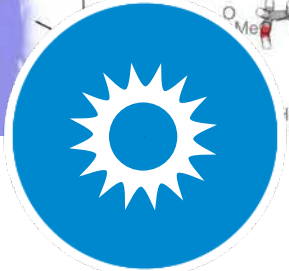
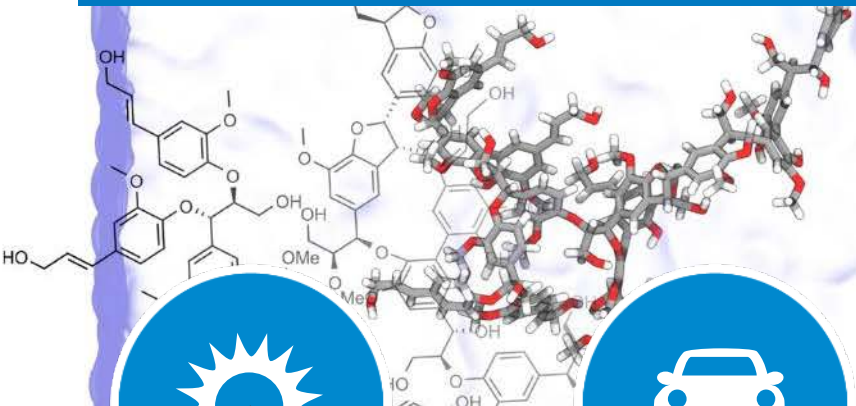


Agreements by Business Type



Funding by Business Type

# NREL Science Drives Innovation



## Renewable Power

- Solar
- Wind
- Water
- Geothermal



## Sustainable Transportation

- Bioenergy
- Vehicle Technologies
- Hydrogen



## Energy Efficiency

- Buildings
- Advanced Manufacturing
- Government Energy Management



## Energy Systems Integration

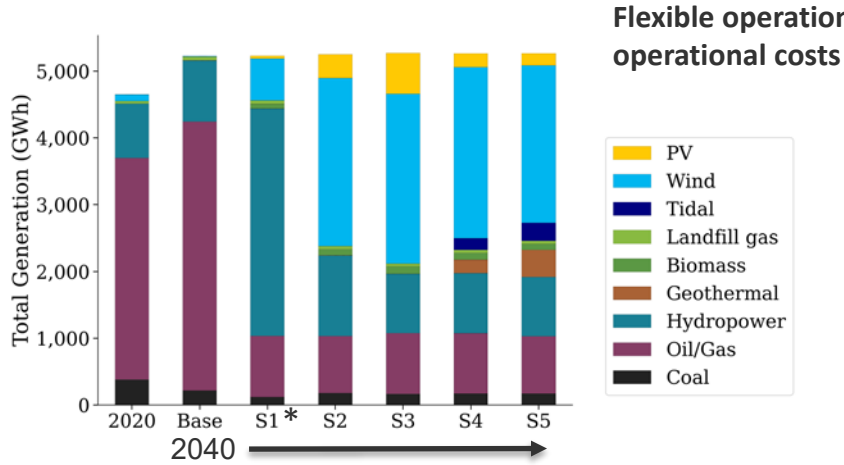
- Grid Integration
- Hybrid Systems
- Security and Resilience



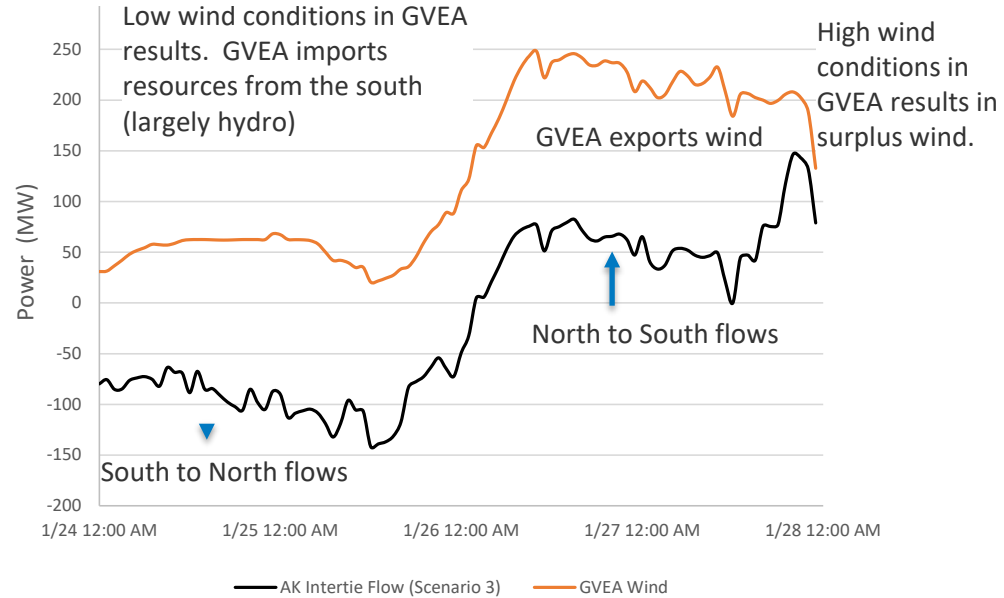
## Alaska Campus Focuses on Energy & Building in Extreme Climates

**Integrating** scientific research and cultural knowledge to unleash **sustainable, equitable** energy, building, and mobility technologies with an emphasis on **rural, remote, and islanded communities** in some of the most **extreme** and challenging regions of the world.

# Helping Alaska Leaders Decarbonize the Power System



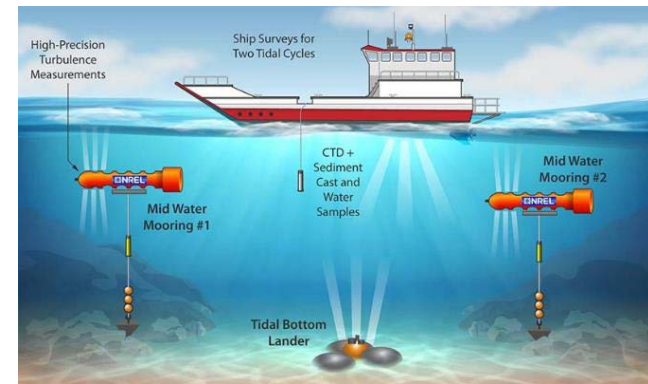
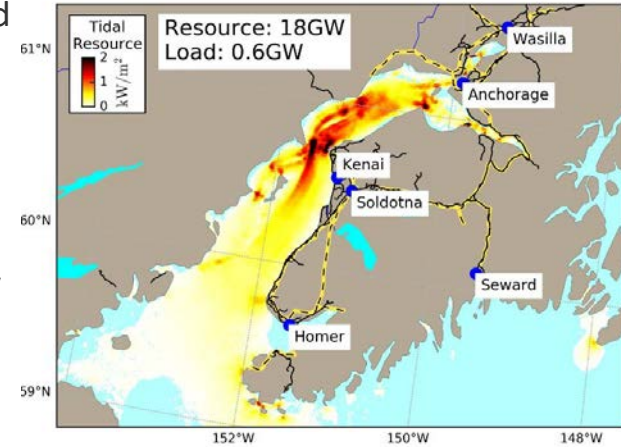
\*Scenarios 1-5 vary largely on new hydropower builds (e.g. Susitna-Watana) and the availability of new tidal and geothermal by 2040.



- NREL performed feasibility study for the Governor's office on achieving an 80% Renewable Portfolio Standard for Railbelt utilities, finding 80% is achievable with wind, hydro, and storage
- An 80% RPS achieves roughly \$426-\$506 million in fuel costs.

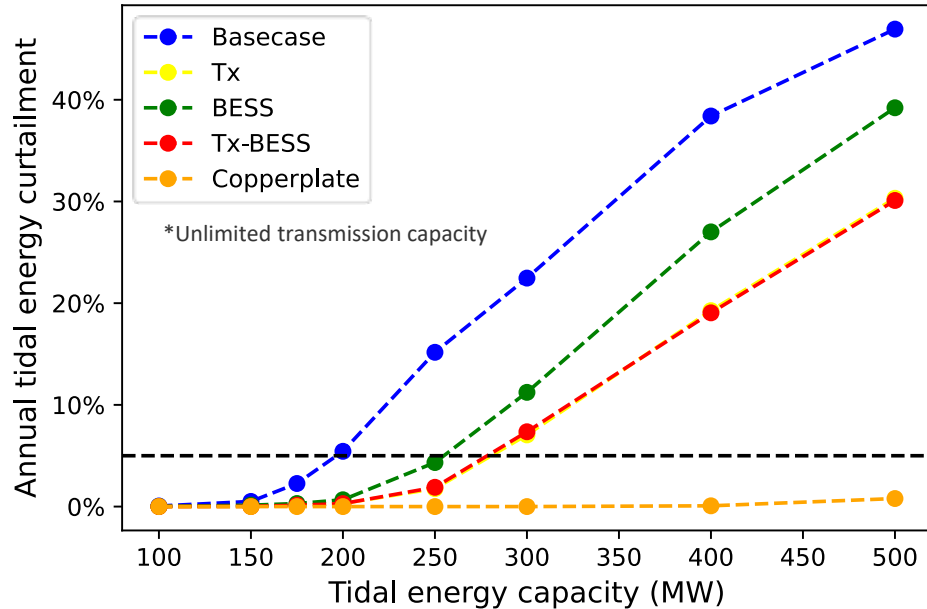
# Developing a Roadmap for Tidal Energy

- Cook Inlet, outside Anchorage, contains 35% of nation's total tidal power, and adjacent to transmission serving 70% of AK
- NREL pilot project characterized tidal resource to determine placement and design of future tidal farm
- 18 GW potential power, enough to meet Railbelt power needs; excess power could be used to produce hydrogen and E-fuel.
- NREL roadmap advises steps for achieving the goal of 100MW by 2035 set by Alaska's tidal energy group

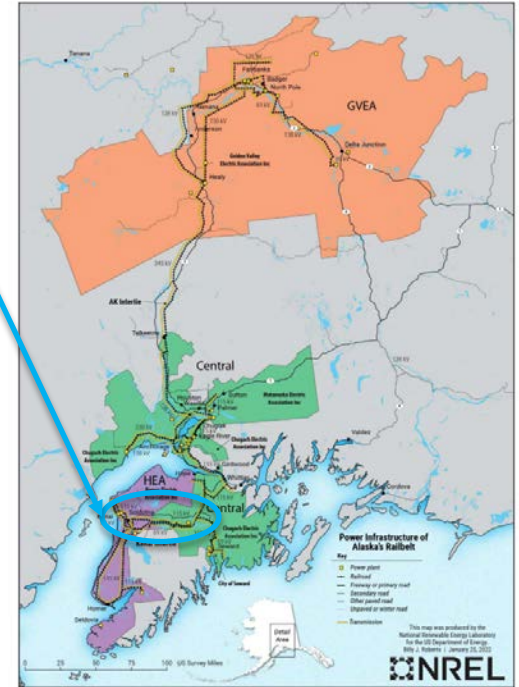


# Studying Infrastructure Upgrades Needed to Integrate Clean Energy

Impact of various infrastructure upgrades on tidal energy curtailment



Kenai Intertie (75 MW), which would transport the tidal energy, to the Anchorage region, presents a major bottleneck.



1. Without major infrastructure investments, the Railbelt could support about 200MW installed tidal capacity without substantial curtailment.
2. Transmission and/or adding energy storage upgrades would increase limit to >275 MW.
3. Tidal energy reduces total Railbelt CO2 emissions by 8-37%, depending on infrastructure upgrades.

# Exploring Marine Energy & Offshore Wind Potential

- NREL used BOEM funding to evaluate the multi-billion-dollar marine energy and offshore wind potential in Alaska from 2022-2024
- Study looked at offshore wind, ocean wave, and tidal sources, identifying best options for deployment in state waters off Alaska's coast
- Also considered practical methods for delivering energy to end users, including the potential for **green hydrogen fuel production**, distribution and end use adoption opportunities.

Marine Cadastre National Viewer |





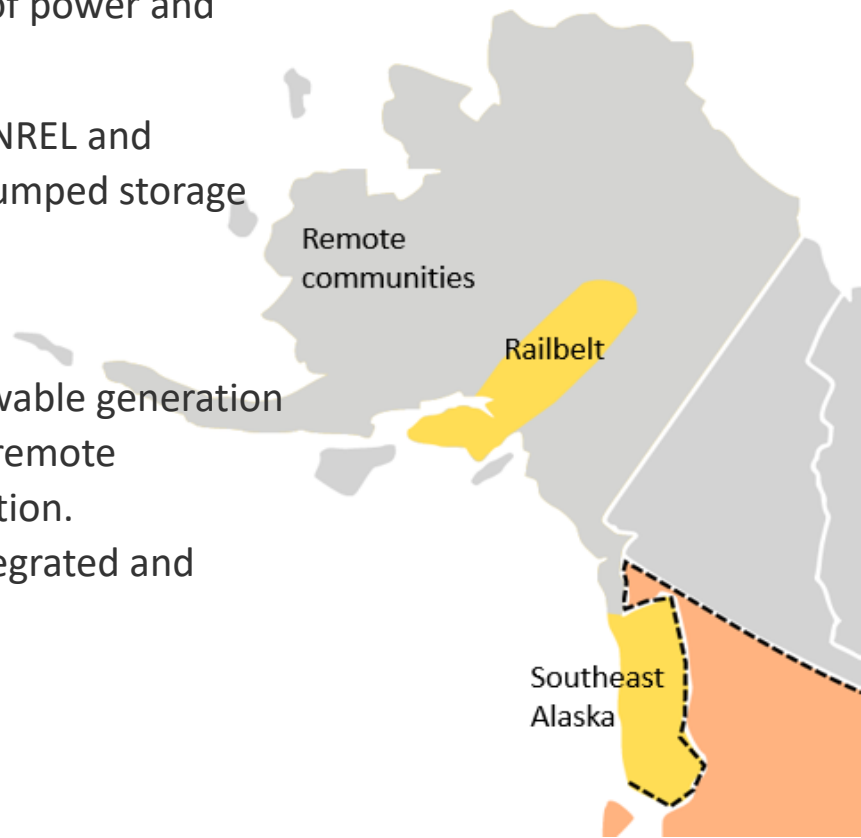
# Investigating Pumped Storage Hydropower in Alaska

Hydropower, combined with pumped storage, has the potential to advance Alaska's renewable energy goals by adding a flexible form of power and enhance energy independence throughout the state.

With funding from DOE's Water Power Technology Office, NREL and Argonne National Lab are investigating opportunities for pumped storage hydro along the Railbelt and rural Alaska.

Goals are to:

- Develop energy storage to support increase renewable generation
- Reduce cost of electricity and improve equity for remote communities that rely on expensive diesel generation.
- Support the reliable and resilient operation of integrated and isolated power systems in Alaska.



# Celium: Growing Insulation from Alaska's Forests

## *Safer Forests, Warmer Homes*

With a \$2.5 million DOE ARPA-e award, NREL and the University of Alaska Anchorage are developing building insulation made of locally-produced cellulose from dead standing timber and mycelium. Goals of project include:

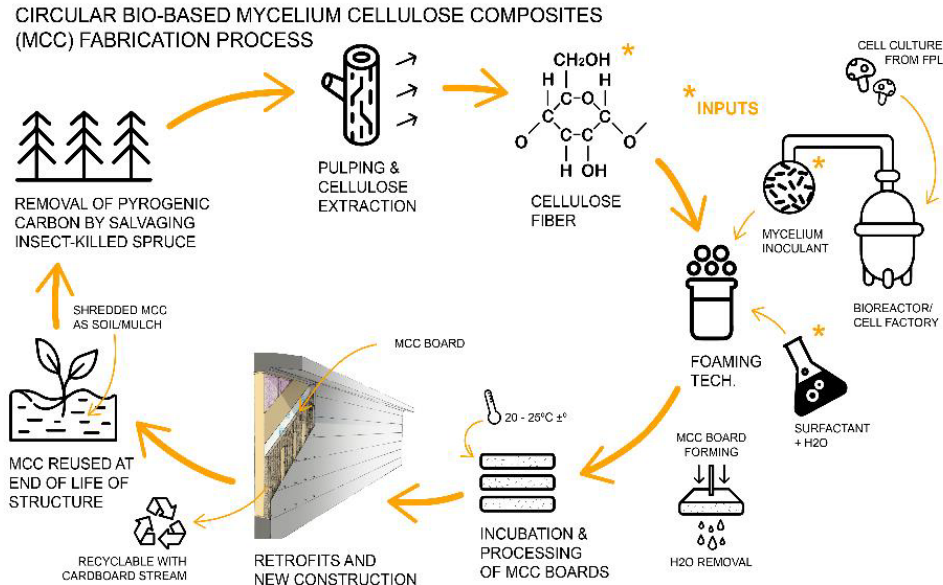
- Creating a carbon-negative building material that uses local materials to produce a needed building resource
- Reducing construction costs AND building emissions in rural Alaska
- Develop modular, portable units that can be deployed in rural communities to develop insulation on-site



# Celium: Growing Insulation from Alaska's Forests

## The Process:

- Cellulose from beetle-killed spruce is ground into a slurry and foamed
- Mixture is inoculated with mycelium, the root network of fungi, and then incubated while the mycelium grows and binds it together
- Mycelium feeds off the cellulose fibers to form a dense matrix in the shape of a sheet of insulation



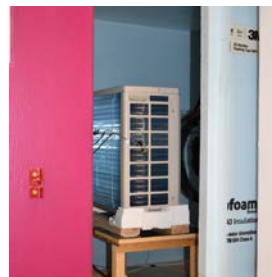
## Project Partners:

National Renewable Energy Laboratory  
University of Alaska Anchorage  
VTT Technical Centre of Finland  
Forest Products Lab  
Cold Climate Housing Research Center, Inc.

# Developing Cold Climate Air Source Heat Pumps to Support Electrification

NREL is evaluating heat pumps in minus-40 Climate Chamber to learn about performance in extreme climates

- With a growing focus on electrification nationwide, heat pumps are key to electrifying heating and cooling loads
- Researchers partner with heat pump manufacturers to evaluate different control schemes for defrost, base pan heaters, and other cold climate elements.
- Evaluations improve design



# Deploying Heat Pumps at Community Scale

“Thermalize Juneau” Pilot project combined community education with bulk ordering/installation to promote mass adoption of air source heat pumps

- Community-driven effort to achieve Juneau’s goal of 80% renewable energy by 2045
- Resulted in 75 homes installing air source heat pumps
- \$2 million HUD Healthy Homes grant funded health and safety retrofits needed to enable heat pumps in low-income housing
- NREL Alaska team provided grant management, workforce training, education & outreach; performed a community survey, compiled results, barriers to participation, and recommendations for making energy campaigns more inclusive



Photos by Alaska Heat Smart

# Improving Energy Efficiency of Alaska Nonprofits

- NREL partnership with Alaska Heat Smart and Information Insights to retrofit nonprofits in Alaska through Department of Energy's Renew America's Nonprofits program.
- Retrofits will focus on improving energy efficiency to help nonprofits achieve comfortable, resilient buildings that allow staff to spend more time on mission.



# Creating Resilient Foundations for Buildings on Permafrost

NREL helps frontline communities develop resilient buildings and infrastructure, including durable, moveable foundations for communities facing coastal erosion and thawing permafrost

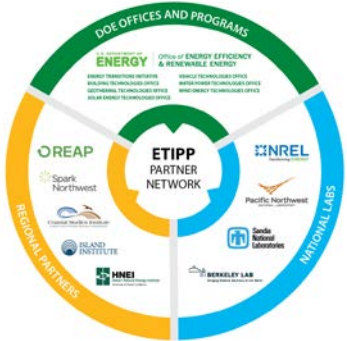
- Worked with the Native Village of Point Lay to assess foundations on rapidly thawing permafrost
- Developed jackable foundations in Mountain Village
- Created innovative “ski” foundation for homes in Unalakleet facing village relocation



# Energy Transitions Initiative Partnership Project (ETIPP) helps remote, coastal, and island U.S. communities increase their energy resilience.

NREL is working with 9 communities in Alaska to conduct energy planning, and implement energy efficiency and clean energy technologies

Proven framework fosters high-impact, replicable community energy transitions.



ETIPP connects communities with energy experts to advance development of resilient energy systems.

LEARNINGS



# Assisting with Energy Planning in Igiugig

NREL is providing technical assistance to Igiugig, Alaska for long-term energy planning, including making river resource measurements for an in-river hydrokinetic pilot project to offset diesel



# Providing Technical Assistance to Alaskan Tribes



Pilgrim Hot Springs

Historic Building  
Energy Efficiency  
Upgrades and  
Rehabilitation Plan



Chilkat Indian  
Village

Energy Efficiency and  
Safety Surveys



Village of Solomon

Tribally Adopted  
Building Efficiency  
Standard



Metlakatla Indian  
Community

Strategic Energy Plan  
Updates

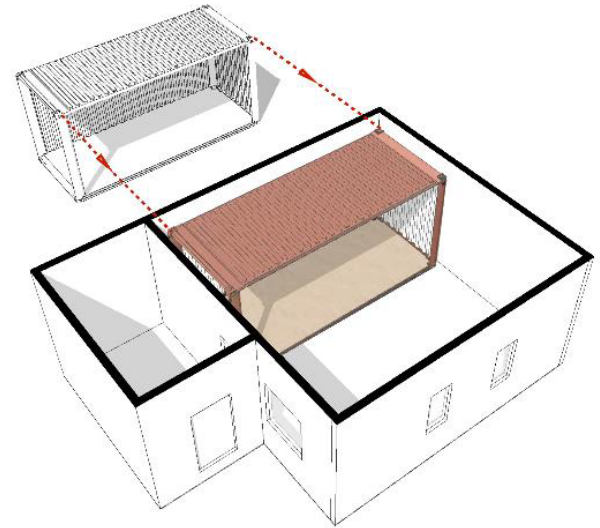
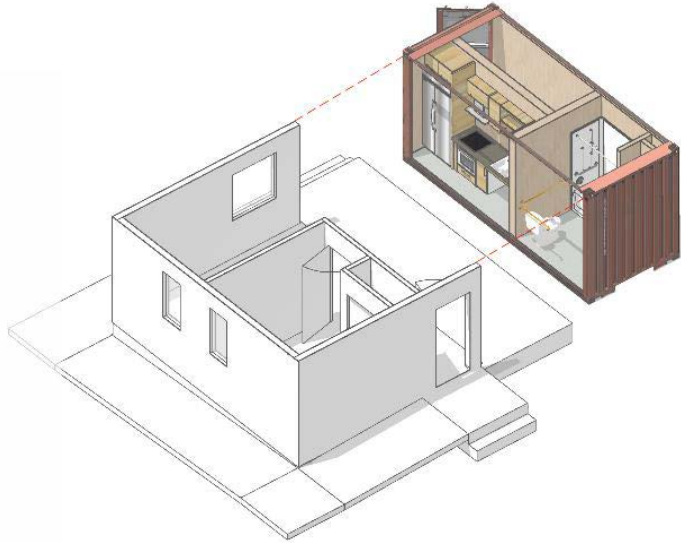


Organized Village of  
Kasaan

Energy Audits and  
Biomass Feasibility  
Study

The U.S. Department of Energy (DOE) Office of Indian Energy provides federally recognized Indian tribes, including Alaska Native villages, tribal energy development organizations, and other organized tribal groups and communities, with technical assistance to advance tribal energy projects.

# Helping Unalakleet Create Climate-Resilient Housing in the Arctic



- Design combines modular and site-built construction to maximize impact in community
- Storage container outfitted with kitchen-bathroom built in lab "plugged into" newly framed home built on-site by local crew
- Modeled to reduce energy costs by 80%
- Semi-modular approach reduces construction costs by 40%
- Climate resilient homes for rapidly changing Arctic

# Semi-Modular Construction Combined Prefab & Site-Built Components



# "Harvest to Home" Program Creates Local Industry & Housing



NREL is working with The Kuskokwim Corporation in southwest Alaska to design a system of milling locally harvested lumber into energy-efficient log housing

# "Harvest to Home" Project Takes Advantage of Local Resources & Labor



Photos from Lindsay Flett

# Healthy Homes Projects Improve Buildings in Rural Alaska



NREL “Healthy Homes” team provides technical assistance to HUD Healthy Homes awardees, including grant management, home surveys, and planning health, safety, and energy upgrades

- Projects in 8 villages including Gakona, Galena, Buckland, Unalakleet, Maniilaq, TNHA/Utqiagvik; remediated 275 Alaska homes as of 2023 in rural Alaska
- Hires and trains local crews to perform surveys and retrofit work
- Provides holistic approach to energy efficiency that incorporates local culture, economic development, and quality of life

# Healthy Homes Project Made Homes in Gakona Safer & More Resilient



- NREL partnered with the Native Village of Gakona and the Cold Climate Housing Research Center, Inc. to retrofit seven homes in Gakona in southcentral Alaska
- Retrofits shored up failing foundations, improved building envelopes, updated lighting and electrical, and remediated structural damage related to mold and permafrost thaw

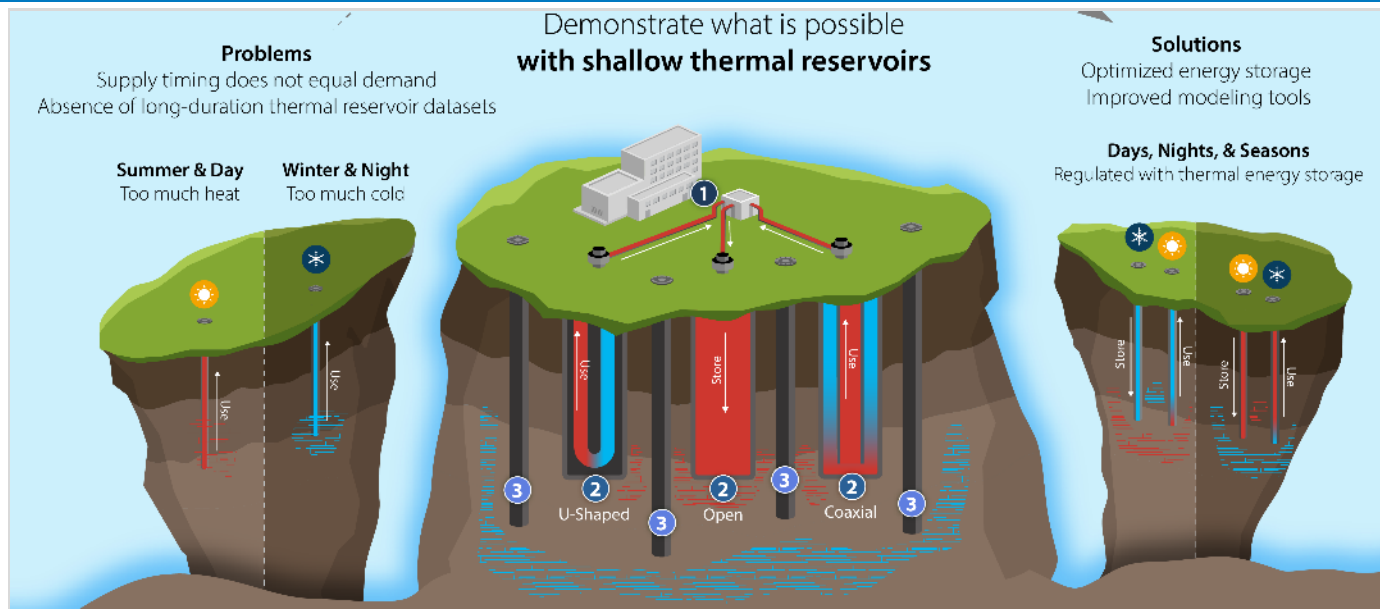




# Investigating Geothermal Solutions with U.S. Defense Department

Project with U.S. Army Corps of Engineers studies geothermal heating strategies for cold climates

- Demonstration project incorporates thermal storage to optimize geothermal in cold soils
- Geothermal could provide affordable heating and improve grid resilience at Alaska installations as DOD targets net-zero energy



# Strengthening Military Readiness by Improving Building Efficiency & Air Quality on Base

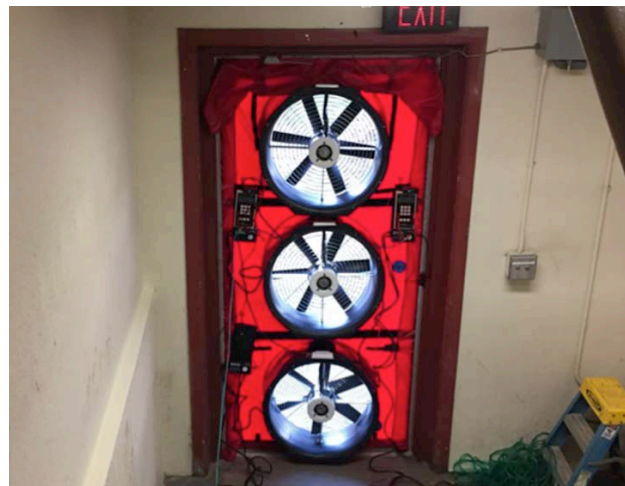
## Partnering with DoD on Secure and Resilient Power Generation in Cold Region Environments

- Conducting building efficiency and alternative energy assessments as part of a broad project to assist Fort Wainwright military base replace its coal-fired power plant
- Working with University of Alaska Fairbanks to compile existing data on Fort Wainwright energy usage and use weather models to simulate the air quality implications of different power generation scenarios (including coal and natural gas)

### Significance & Impact

Build partnerships with DoD's Construction Engineering Research Laboratory and Cold Regions Research and Engineering to advance efficiency, durability, and resilience of cold climate military installations

Help plan the next generation of power systems to minimize environmental impact



# Helping DOD Improve Climate Resilience in Alaska

NREL is partnering with Alaska Army National Guard at Joint Base Elmendorf-Richardson, Clear Space Force Station, Eielson Air Force Base, Fort Wainwright and Fort Greely to perform:

1. Microgrid designs for Guard installations
2. Building energy assessments for improved efficiency
3. Assessment of energy use for new technologies





NREL/PR-5600-88977

*Photo by Dennis Schroeder, NREL 552001*

Photo Courtesy Cold Climate Housing Research Center