Supporting Innovation in the Energy Transition

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NREL at a Glance

3,675 Workforce, including:
• 2,732 regular/limited term
• 490 contingent workers
• 211 postdoctoral researchers
• 152 graduate student interns
• 90 undergraduate student interns
— as of 9/30/2023

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

More Than 1,000 Active Partnerships in FY 2023

Agreements by Business Type

Funding by Business Type
NREL Science Drives Innovation

Renewable Energy
- Solar
- Wind
- Water
- Geothermal

Sustainable Transportation & Fuels
- Bioenergy
- Hydrogen and Fuel Cells
- Transportation and Mobility

Buildings and Industry
- Buildings
- Industrial Efficiency and Decarbonization
- Advanced Materials and Manufacturing
- State, Local, and Tribal Governments

Energy Systems Integration
- Energy Security and Resilience
- Grid Modernization
- Integrated Energy Solutions
NREL Brings Distinct Capabilities

**Foundational Science**
- Bench-scale discovery

**Accelerated Technology Scale-Up**
- Scaling R&D and Process Engineering
- Energy Materials and Processing at Scale (Completion 2025)
- Energy Systems Integration Facility

**Carbon-free H2**
- Products from electrochemical processes and CO2
- Advanced Batteries
- PV, Wind, Water Power, Geothermal
- New Buildings and Industrial Materials, Manufacturing and Systems
- Grid and security tech

**Systems**
- Advanced Research on Integrated Energy Systems

**Markets**
- R&D with Industry Partners

- Solar Energy Research Facility
- Science and Technology Facility
- Field Test Laboratory Building
- Advanced Research Computing, Simulation, and Visualization
Why Can’t Industry Do What We’re Doing?

Industry invests in short-term R&D when they are confident about a return on investment.

**NREL:**

- Assumes a longer, broader view.
- Takes on early-stage, high-risk R&D.
- Conducts research that makes it possible for industry to bring important new solutions to the market.

“It is often too risky for the private sector to be on that bleeding edge of research where profits are years and years away.”

Venkatesh Narayanamurti, Professor of Science and Technology Policy, Harvard Kennedy School, told *The Washington Post*
Resources at the Edge

Advancing the Energy Transition in Communities
NREL has partnered with and supported more than 3,000 communities, tribes, jurisdictions, utilities, and businesses for energy transitions planning, technical assistance, capacity building, workforce development, and more.
The collective power of DOE and the national labs helps communities reach their goals

**Stakeholder engagement and decision support**
Map and assess actionable pathways for achieving clean energy goals, with continuous community input

**Customized modeling and analysis**
Apply customized tools to provide decision-supportive analysis on critical policy and technology decisions

**Simulation, emulation, and validation**
De-risk large-scale deployments through realistic simulations/emulations on the ARIES platform

**Local capacity building and training**
Support workforce and institutional capacity development on clean energy, equity, policies, smart buildings, electric transportation

**Peer-to-peer learning with other communities**
Work through coalitions to leverage lessons from other jurisdictions and share best practices
C2C: Tailored Support to Transform Community Clean Energy Ambitions Into Tangible Results

Inspired by LA100, C2C enhanced capabilities with ARIES validation is scaling technical innovations.

C2C: Clean Energy to Communities

U.S. DEPARTMENT OF ENERGY

Multiple teams of utilities, local governments, and community-based organizations in the first 3 years

ARIES

One utility over 3 years

Pathway analysis

(Technical Advisement)

(Implementation)

The Los Angeles 100% Renewable Energy Study

(Community-Led Goal Setting)
By emulating community assets and grids, we can reduce uncertainty and risk in energy project deployment and accelerate transition.
ETIPP connects remote and island communities with regional and national energy experts who can provide strategic energy analysis and planning for local energy resilience projects.

7 U.S. DOE Offices
Funding, support, expertise
Foster cross-technology collaboration, planning and solutions

5 Regional Partners
Local, trusted, community-based
Stakeholder engagement and outreach

4 National Labs
Deep energy-sector experience, expertise
Technology-neutral technical assistance

32 Communities
Unique challenges, values, goals
Identify energy challenges and ideal transitions
Share experiences and learnings, regionally and internationally
ETIPP Community: Sitka, Alaska

**Project goals:** Support a growing community with changing needs by providing:

- Long-term planning to address anticipated energy needs
- A strategy to **minimize rate impacts** on customers
- Solutions to **bolster energy resilience** and **minimize climate impacts** (e.g., avoid future reliance on diesel)
- Data to secure **financing** for energy investments

**Scope:** Assess available renewable resources in and around the community while planning for a more modern grid control system

1. **Generation planning:** Renewable energy assessment
2. **Microgrid planning:** Grid model development and training
3. **Optimization of resources for economic benefit:** Evaluation of green energy export options

*Photo by Grant Turner, City and Borough of Sitka*
Steady-State and Dynamic Grid Model Development

**Steady-state model of electric grid**
- Leveraged existing data from City and Borough of Sitka (CBS)
- Built model in an open-source tool for planning and designing distribution systems
- Planning tool for CBS
  - Simulate distribution system power flows
  - Test various scenarios (operational, added generation resources, changing loads)
  - Evaluate value of new controls before investment
  - Sync with other commercial tools

**Dynamic Grid Model**
- Built dynamic grid model based on steady-state model
  - Evaluates grid stability and control impacts with addition of renewable energy generation
- Existing hydro and load control can support up to 9 MW of intermittent renewable energy integration
- Higher levels of wind/solar integration will require microgrid controls, upgrades to existing hydro/load control, and/or battery storage.
ETIPP is assisting Tideland Electric Membership Corporation (EMC), the utility provider for Ocracoke, in assessing the prospect of electrifying their ferry fleet.

Activities

• Data collection and site assessment

• Assess the current state of electric marine transportation technologies

• Perform a feasibility and cost-benefit analysis
Approach

Routes
Determine routes for electrification and travel details (duration, distance...)

Schedules
Assess service schedules to determine ferry dwell

Energy
Assess energy needs per route to determine charging requirements during dwell

Power
Assess EVSE options and vessel energy storage needs

Site
Consider installation requirements including grid and port upgrades
Thank You