NREL
Transforming ENERGY

Supporting Innovation in the Energy Transition

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IEEE Green Energy Conference

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Photo by Werner Slocum, NREL 69160

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:

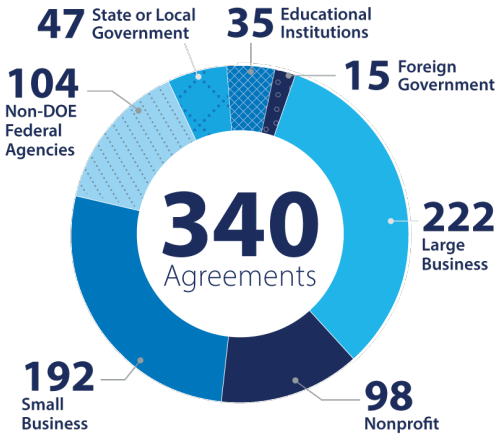
- Renewable Energy
- Sustainable Transportation & Fuels
- Buildings and Industry
- Energy Systems Integration

Partnerships with:

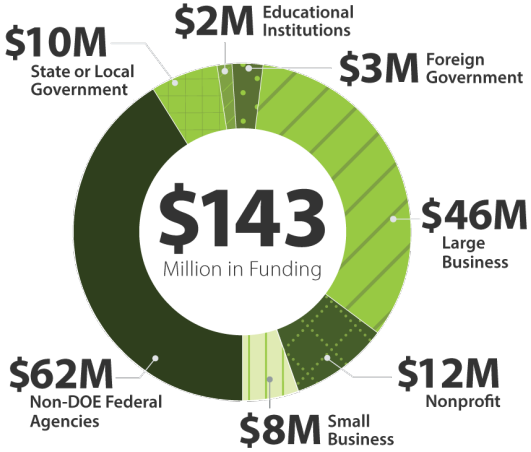
- Industry
- Academia
- Government

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

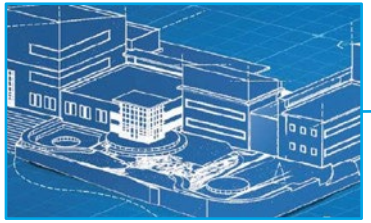
Photo by Werner Slocum, NREL 66364

NREL Brings Distinct Capabilities

Foundational Science
Bench-scale- discovery

Solar Energy Research Facility
Science and Technology Facility
Field Test Laboratory Building

Accelerated Technology Scale-Up
Scaling R&D and Process Engineering

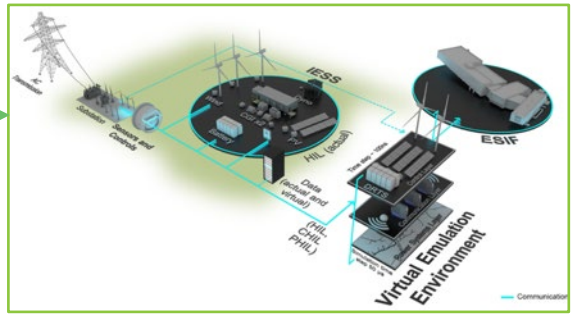


Energy Materials and Processing at Scale (Completion 2025)

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
Markets
R&D with Industry Partners



Advanced Research on Integrated Energy Systems

High-Performance 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:

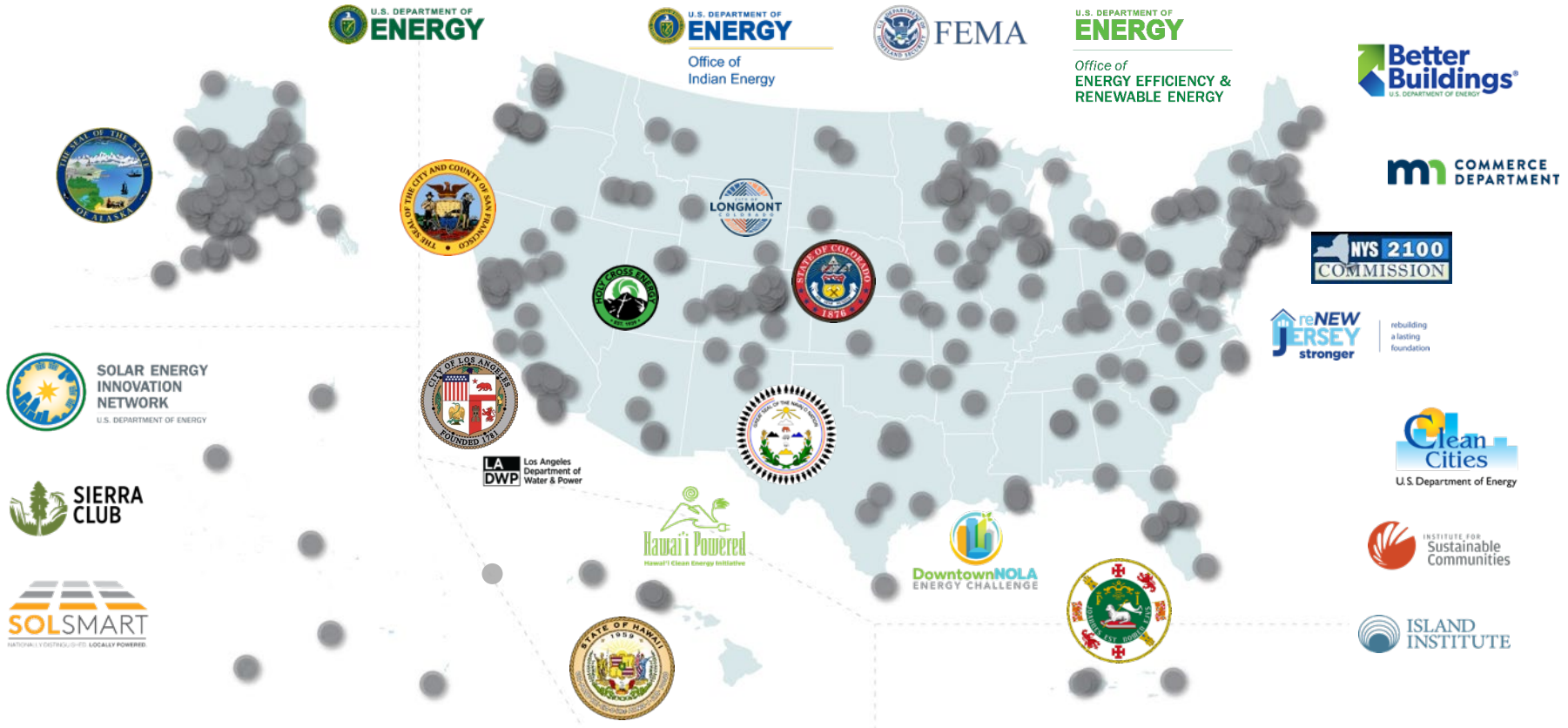
- Assumes a longer, broader view.
- Takes on early-stage, high-risk R&D.
- Conducts research that makes it possible for industry to bring important new solutions to the market.

"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.

One utility **over 3 years**

LA100
The Los Angeles 100% Renewable Energy Study

(Community-Led Goal Setting)

Pathway analysis

ARIES

\+ Validation

(Technical Advisement)

C2C: Clean Energy *to* Communities

U.S. DEPARTMENT OF ENERGY

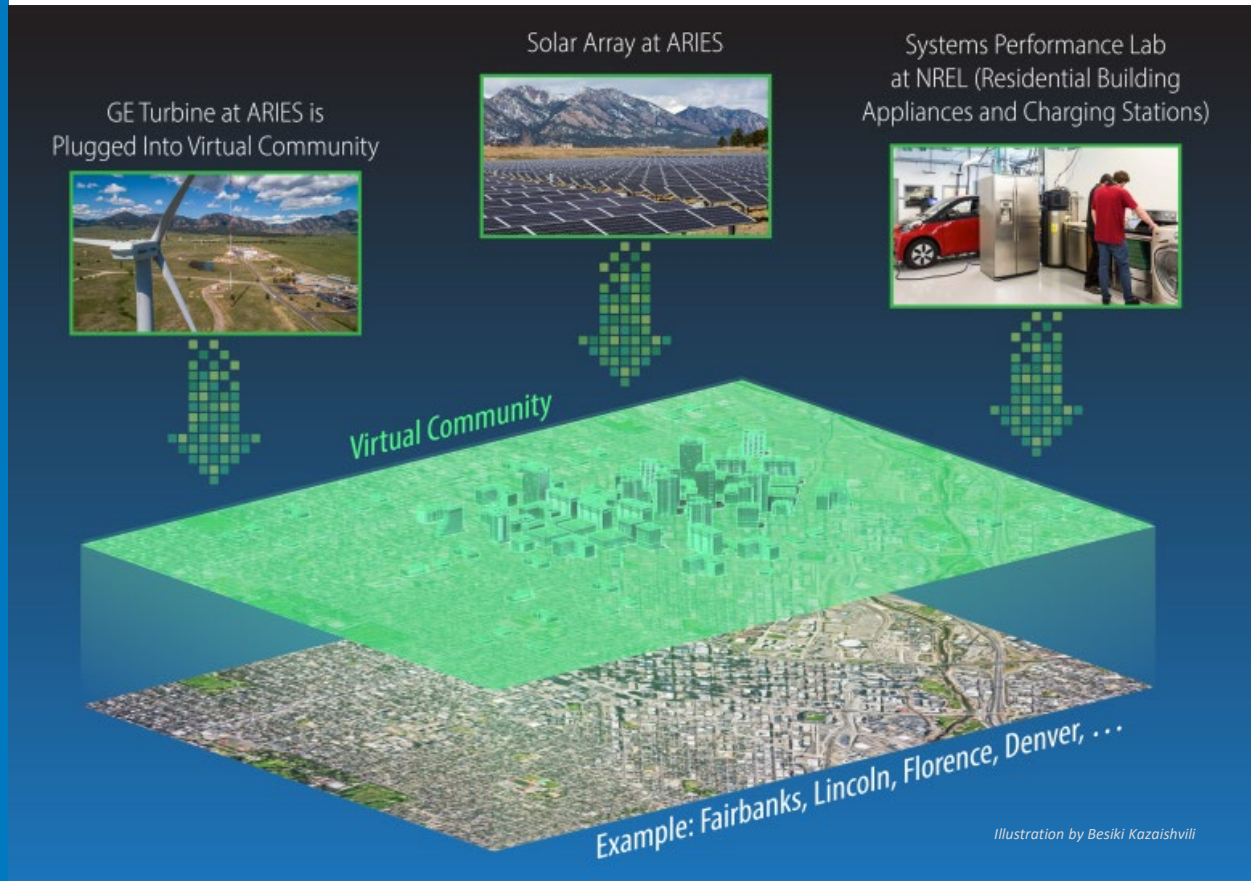
Multiple teams of utilities, local governments, and community- based organizations in the **first 3 years**

(Implementation)

Solving Integration and Operation Challenges before Installation

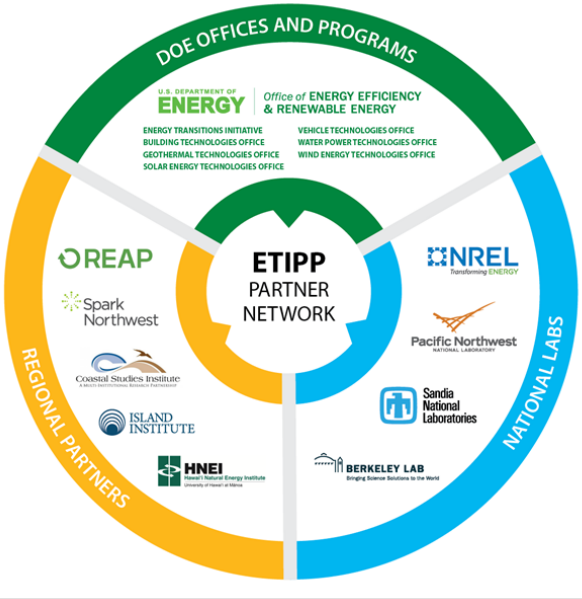
By emulating community assets and grids, we can reduce uncertainty and risk in energy project deployment and accelerate transition.

ARIES by NREL



ETIPP Overview

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

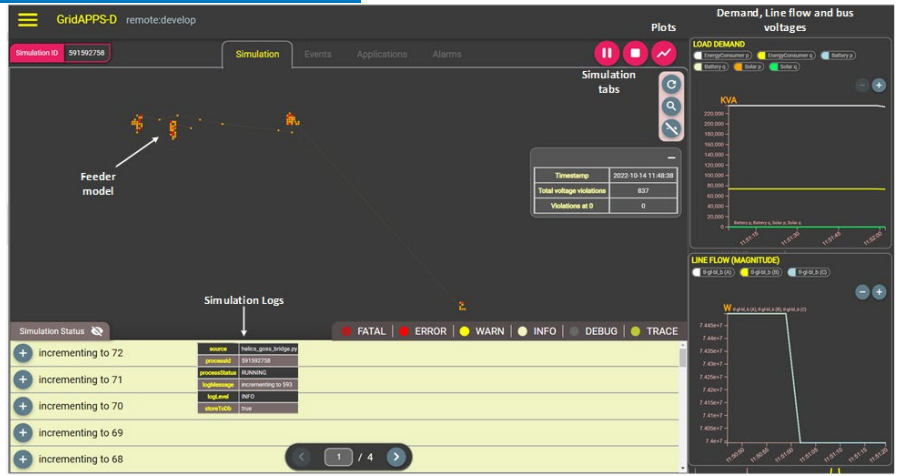
1. *Generation planning*: Renewable energy assessment
2. *Microgrid planning*: Grid model development and training
3. *Optimization of resources for economic benefit*: Evaluation of green energy export options

Photo by Grant Turner, City and Borough of Sitka

Steady-State and Dynamic Grid Model Development

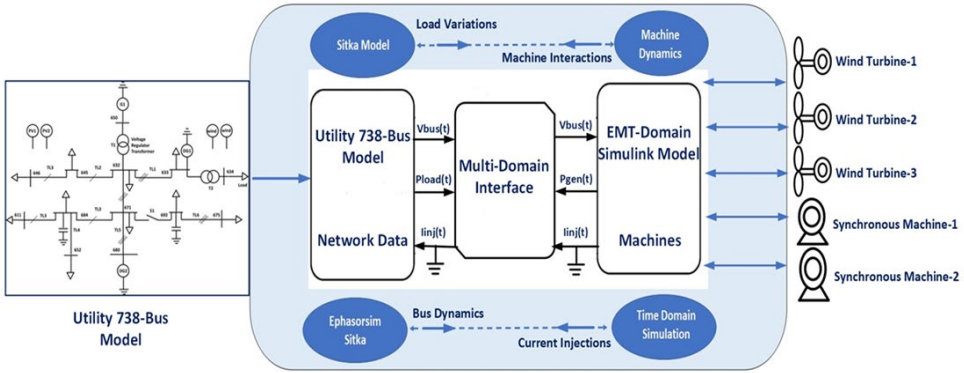
Steady-state model of electric grid

- 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



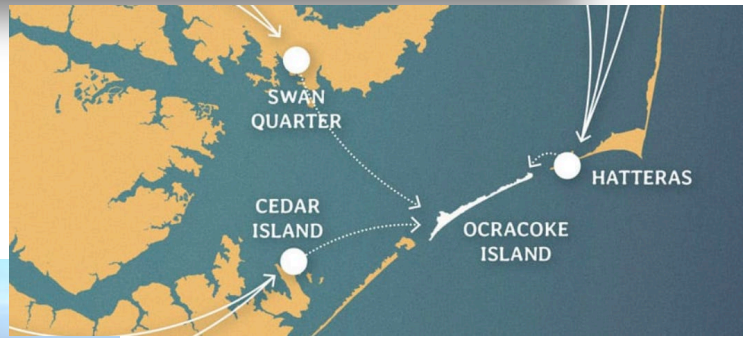
Dynamic Grid Model

- 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 Community: Ocracoke, NC

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

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